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ABSTRACT

Eight papers are presented from the 1995 CAUSE conference track on strategic planning issues faced by managers of information technology at colleges and universities. The papers include: (1) "Can Small Colleges Afford To Be Technology Leaders? Can They Afford Not To Be? (Martin Ringle and David Smallen); (2) "Strategic Planning Across Multiple Organizations: Community College MIS Consortium and the Central Oregon University Center" (Martha Romero and others), which focuses on management information systems collaboration at the College of the Siskiyous, Arizona State University, and Central Oregon University Center; (3) "Multi-Faceted Planning in 'REAL' IT" (Wayne Ostendorf and Michelle Stotts), on strategic planning at Iowa State University; (4) "OLAP/EIS Tops Off the Data Warehouse" (Henry M. Stewart), which examines the use of On-Line Analytical Processing technology at the University of Rochester; (5) "You CAN Teach an Old Dog New Tricks: Extending Legacy Applications to the New Enterprise Architecture" (Nicholas C. Laudato and Dennis J. DeSantis), which discusses the integration of old and new information technology at the University of Pittsburgh; (6) "Strategic Planning for a Library, Computing and Media Support Organization" (Maureen Sullivan and Patrick Calhoun), which focuses on the University of South Carolina; (7) "Restructuring the Information Technology Organization To Improve User Services and Return on Investment: Do Compromises Work?" (Keith R. Nelson and Richard W. Davenport), which highlights the experiences of Central Michigan University; and (8) "The Financial Mythology of Information Technology: The New Economics" (John L. Oberlin). Some papers contain references. (MDM)

CAUSE 95
New Orleans
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# TRACK 1
## STRATEGIC PLANNING

*Coordinator: Fritz Hibbler*



# *Realizing the Potential of Information Resources:*
## *Information, Technology, and Services*

Proceedings of the
1995 CAUSE
Annual Conference

# Can Small Colleges Afford To Be Technology Leaders?

# Can They Afford Not To Be?

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## Abstract

Small colleges, troubled by demands on financial aid, constrained by external pressures to limit the growth of tuition and fees, and driven by increased competition for students, appear poorly positioned to be technology leaders. However, in these difficult times they have opportunities to distinguish themselves through focused applications of information technology resources in support of their missions. Taking a leadership role in technology can have significant payoffs as well as substantial risks. In this paper we examine both the costs and benefits of technology leadership for small colleges.[1]

[1] Questions or feedback about the paper is welcomed and should be directed to Martin Ringle at ringle@reed.edu or David Smallen at dsmallen@itsmail1.hamilton.edu.

## Institutional Characteristics and Technology

It is important to note that over sixty percent of all institutions of higher education have less than 2,500 students and that small colleges differ from large universities in numerous ways. One of the more important distinguishing characteristics of small colleges is the scarcity of resources they can apply to the pursuit of technology goals. While all institutions of higher education are challenged by the cost of technology, smaller institutions are unable to achieve the economies of scale available to large universities hence they are especially hard-pressed to provide adequate staff support, network enhancements, software customization, and equipment replacement to maintain campus-wide technological currency.

Of equal importance, however, is the fact that small colleges generally emphasize teaching and learning as central features of their institutional missions, while placing less importance on the role of faculty research. Even at selective liberal arts colleges, where the scholarly activities of the faculty are rewarded through tenure and promotion, support for new technology is rarely a top institutional priority. Research universities and other institutions, by contrast, take great pride in their applied research achievements and the creation, acquisition, or deployment of the latest technology.[2]

In a climate of scarce resources and with technology a comparatively low institutional priority, it is not surprising that both the faculty and the administration of many colleges believe that this type of leadership must be found elsewhere. Indeed, when strategic questions about technology arise, small colleges commonly look to large universities for solutions.

## The Problem with University Paradigms

The difficulty with seeking technology models elsewhere, however, is that solutions which are appropriate for institutions like Cornell University or the University of Washington do not easily scale to colleges such as Hamilton or Reed. This is true for almost every aspect of technology deployment and support, from methods of funding and equipment allocation to strategies for the development of administrative information systems. There are, of course, exceptions: a graphics workstation for undergraduate chemistry instruction may be equally suitable at Ohio State or Oberlin. In most cases, however, technological solutions at small colleges cannot be obtained by simply "shrinking" the approaches taken by large universities. The list of technical and organizational differences is a long one; consider just a few examples:

In a large university administrative data processing operations often support a multitude of fiscally autonomous and semi-autonomous organizations. The complexity inherent in these types of environments typically demands institution-

[2]Some of the most widely used software packages in higher education were developed, with extensive institutional support, at research universities. For example: B.S.D. Unix (UC Berkeley), X-Windows (M.I.T.), Gopher (Minnesota), and Mosaic (Illinois).

specific financial management software and, not unexpectedly, a programming staff of considerable size. Small colleges, by contrast, tend to have unified, top-down financial organizations, which neither require nor can afford a large staff of programmers. As a result, small colleges tend to rely more on relatively low-cost, off-the-shelf, integrated packages that need little customization and (at worst) a modest-sized programming staff.

Likewise, consider the differences in networking. Computing organizations at large, multi-campus universities often view networking primarily as the provision of backbone services to a hegemony of "LAN fiefdoms." Promoting university-wide protocol standards and maintaining interfaces for e-mail packages and other inter-group software tools, is a full-time challenge. Small colleges, on the other hand, are far more likely to be responsible for designing and maintaining networking for the entire institution. Much of the large-university complexity brought about by interoperability demands is simply absent. As a consequence, many of the hardware, software, and staffing solutions suitable for a large university network are simply irrelevant to small institutions.

Further, universities have a long history of using technology fees and chargeback mechanisms to fund computing services, and restricting computing access to students in particular courses. These practices are foreign to small institutions which generally finance educational programs through tuition charges and institutional funds.

Thus in many cases small colleges must seek technology leadership within their own ranks, or look to collaborative relationships with universities or peer institutions for workable strategies.

## Some Opportunities for Technology Leadership[3]

Technology leadership defies precise definition. The most obvious type of leadership, the creation of new software or hardware technologies, is beyond the scope of most small colleges. Rarely can these institutions devote significant professional staff or financial resources to such endeavors. The result is that the impact of software development is usually confined to a small number of courses and disciplines at a modest number of schools. Further, hardware and software incompatibilities have limited the portability of such software to other institutions.[4] Traditionally, therefore, the development of new technology has not been an easy avenue of leadership for small colleges.

The World Wide Web – The recent incredible growth of activities on the World Wide Web augurs a significant new opportunity for small colleges. Unlike earlier generations of software, preparation of Web materials may be accomplished without requiring a major investment in a large professional staff. The Web allows faculty at different institutions to build upon the work of others, often collaboratively, to

[3]Additional opportunities for leadership are implied in the *Evaluation Guidelines for Institutional Information Technology Resources* (HEIRA, 1995).

[4]In spite of these hurdles, however, faculty at several small colleges have created instructional software of distinction, that has won national awards and enjoyed broad dissemination.

enhance the learning environments for their students. This is a particular opportunity for small colleges because of their emphasis on teaching and learning. Further, the relative hardware and software independence of Web activities makes this collaborative process feasible for virtually any college. During the next two or three years, development of Web materials is likely to provide unprecedented opportunities for small colleges to exercise technology leadership, individually and in collaboration with others.

Curricular applications of technology – While large universities excel in many ways, most education professionals agree that the highest quality undergraduate instruction is found in small colleges. Using this as a foundation, small colleges can play a leadership role by finding ways to innovatively apply available technologies to enhance teaching and learning. A technology leader in this regard uses technological resources in new ways to address different learning styles, illuminate difficult concepts, accelerate the acquisition of knowledge, and prepare students for a lifetime of learning. For example, the Reed chemistry department has redesigned large parts of its curriculum to incorporate computational research tools. Molecular modeling packages such as SPARTAN and Midas, together with visualization software developed at Reed, are being used to enrich students' understanding of basic principles of molecular behavior. Many other departments at Reed, from biology to classics, have used available software packages to promote a higher degree of independent student research.

Hamilton College has likewise been involved in curricular technology initiatives in a number of departments. Its economics department is using simulation software developed at the University of Arizona to help students learn about economic markets through multi-person games. A Hamilton anthropologist and his students participated in Project Solsys[5] to design a space station by collaborating with students at other colleges via the Internet. And members of the Hamilton biology department have been using the BioQuest[6] library, a compendium of computer-based tools, simulations and textual materials that supports collaborative, research-like investigations in biology classrooms and laboratories.

Institutional efficiency – Operating in an efficient manner helps to reduce the costs of achieving the institutional mission. The use of technology has become almost mundane in the daily operations of higher education institutions — we can't imagine how we could do business otherwise. However, truly innovative applications of technology which redefine, in some sense, the way business is done, are still rare and characteristic of strong leadership. Technologies which enable us to do more effective student recruiting, to track prospective donors with more precision, or to analyze financial aid requirements more reliably, without adding staff, help colleges operate more cost-effectively.

At Hamilton, for example, career services has been substantially transformed by using Web technology. All recruiting opportunities for students are published on the Web. On an average day, more than 30 changes are made in contact persons, telephone numbers, deadline dates, etc.. Over the course of the semester, using the Web allows

[5]Project SOLSYS is coordinated by Northern Arizona University.
[6]The BioQuest project is coordinated by Beloit College.

career services personnel to reinvest hundreds of hours of staff and student time while making information about recruiting available to students any time of the day or night. But perhaps, the most exciting change is Hamilton's involvement in a cooperative venture to share the expertise of career services personnel – nationwide – through a Web effort called the Catapult.[7] These activities not only promote efficiency, but improve the quality of services provided.

Access to electronic resources – While some traditional metrics, such as the total number of computers on a campus, may be little more than public relations fodder, the ability to provide students, faculty, and other members of the college community with excellent access to electronic resources presents a genuine opportunity for leadership. Institutions can achieve a good deal of recognition for providing high-speed, reliable, and secure network access from anywhere on campus, including offices, classrooms, labs, dormitory rooms, the library, and so forth. Increasingly, colleges are also providing friendly means of off-campus access to faculty, alumni, parents, donors, and others associated with the college. Swarthmore and Trinity University (TX) have both received national attention for their innovative approaches involving electronic services for alumni.

Organizational innovation – In an era characterized by so many changes and challenges, colleges need to have information technology organizations that are nimble, fluid, and maximally responsive to users' needs. The days of isolated departmental units for academic computing, administrative computing, telecommunications, audio-visual technologies, library resources, and the like are gradually disappearing. Colleges are recognizing that all technologies and information resources need to be tightly coordinated in order to achieve optimal institutional strategies. Gettysburg College, for example, has taken a bold step in creating an organization where all library and technology resources report to a vice president for strategic information resources. While this may not be an appropriate solution for all small colleges, it does demonstrate technology leadership in the realm of organization.

Infrastructure – Creating and maintaining a modern technical infrastructure is a resource intensive activity, often beyond the means of small institutions. Even among institutions with considerable financial resources, the expectations for the quality of the hardware, software and networking environment often exceed the institution's capacity. However, there are a number of strategies that small colleges can use to enhance the likelihood of distinction in the creation of an excellent infrastructure, and to maximize the institutional investment in it.

Controlling the diversity of hardware and software will minimize support costs, particularly the staff resources necessary to answer questions, provide training, and assist with upgrades. Adhering to established standards and mainstream products across the entire institution make it more likely that the infrastructure can be efficiently managed. These are particular opportunities for small colleges that are often unavailable to large universities.

[7] See the *Chronicle of Higher Education*, July 14, 1995.

Fiscal strategies for technology – As any college financial officer knows, the cost of technology is one of the major "black holes" of the institutional budget. Colleges that establish creative ways of dealing with technology funding clearly have an opportunity to exercise significant leadership. For example, Hollins College provides a model of how to reduce the cost of campus networking by forming a partnership with a local cable TV provider. Institutions, like Reed, that have managed to increase the availability of computer resources while maintaining a constant technology operating budget level also play a leadership role.

## Benefits and Risks of Technology Leadership

Pursuing a technology leadership position has both rewards and risks. Many small colleges pointedly avoid being in the technological vanguard and prefer instead to be "early followers" or simply to remain "near the median." We explore some of the potential benefits of pursuing technological leadership and then examine some of the risks associated with being on the "bleeding edge."

### Benefits

Enhanced learning environment – Without question, the most compelling benefit of being a technology leader is to provide students with the best possible opportunities for learning. This is clearly the primary motivation behind Reed's innovative use of technology in biology and chemistry instruction, of Mill's use of advanced technology for music composition and synthesis, and of Hartwick's practice of providing every entering student with a personal computer. If the overriding goal of a small college is to offer students the best possible environment for learning, then being a pioneer in instructional uses of technology can help to achieve that goal and thus to underscore an institution's curricular strengths.

In the coming years, as enrollment and financial pressures on small colleges mount, it will become increasing critical for these institutions to distinguish themselves from one another by more than geography, architecture, or cost; successful institutions will be those that are perceived as having particular unique — or at least highly competitive — programs in specific curricular areas. Some in higher education believe that in addition to having the best faculty, colleges will also need to have the best information resources and technology in order to justify claims about disciplinary strengths. They further believe that being a technology leader in this regard is — or will soon be — a prerequisite for instructional excellence, hence a key component for fulfilling one's institutional mission.

Campus-wide services – Basic to the integration of technologies into the campus environment is providing excellent support services. Institutions can demonstrate technology leadership in the way they provide services that address important needs in the campus community. Thus, for example, Occidental College has provided students with a graphical utility for remote registration which is friendly, efficient, and radically superior to the traditional methods of registration. Others colleges that have reviewed the Occidental approach view it as a valuable model for the design of their own registration systems. Hamilton's collaboration with Cornell University's

Institute for Social and Economic Research (CISER) has provided faculty and students with access to vast social science databases and the expertise to use them — access and skills that would otherwise be unavailable in a small college setting.

Attracting outside funding – During the 1980s individuals, private foundations, and government agencies provided substantial funds to allow colleges to take advantage of new technologies. While the availability of such funding has declined, and competition for it has increased, there are still many opportunities to obtain sizable grants. Many technology grant decisions, however, are based on the likelihood that the recipient will be capable of doing something truly innovative and that other colleges will be interested in the results. Establishing a reputation as a technology leader, in almost any of the categories mentioned above, can help an institution to attract external funding. Reed, for example, by serving as a model of technology innovation among liberal arts colleges, has received millions of dollars in grants in the past ten years to underwrite substantial portions of its network, microcomputer labs, advanced workstation facilities, software acquisition, library automation system, and other electronic resources. Likewise, Hamilton (in conjunction with Colgate University) recently received a Mellon Foundation grant for infusion of information technology into modern language instruction. The award was based partly on each institution's commitment to work collaboratively as a way to maximize the use of electronic resources.

Developing favorable relationships with technology vendors – A similar benefit applies to vendors of software, hardware, and services. While the prolific equipment grants of the 1980s, like foundation funds, are no longer abundant, there remain numerous opportunities for a college to acquire new technology at little or no cost by having a reputation as a technology leader. Recognizing the ongoing importance of "reference sites" among different sectors in higher education, vendors continue to be willing to make special allowances for schools that are perceived to be leaders in one area of technology or another. In addition to grants and deep discounts, technology leaders also benefit from favorable vendor relationships by learning of new products early in the development cycle and, in some cases, by having input into both product and marketing strategies. Technology leaders which are invited to participate in focus groups or educational advisory boards, or who serve as beta- or early-support-sites, may play a small but nonetheless important role in shaping the direction of future educational technologies.

Recruiting – Using technology to improve the learning environment, the quality of campus life, extra-mural funding, etc., may contribute to the ability of a college to attract and retain outstanding students and faculty. Several years ago, the claim that a decision of whether or not to attend or work at a particular college was based on the availability of electronic resources was most likely the product of a chief information officer's overworked imagination. Today this is no longer true. At Reed, for example, prospective students (and their parents) frequently inquire about dormitory networking, electronic library resources, access to the Internet, etc., during the application process or a campus visit. Likewise, prospective faculty members often raise detailed questions about electronic resources they may require for instruction or research purposes. While a variety of other factors are undoubtedly critical to the decision of whether to attend or work at a particular college, the lack of sufficient technological resources may be instrumental in a decision not to attend (or work at) an institution.

Service to peers – Finally, we must recognize that when a small college investigates a new technology, organizational structure, or fiscal strategy it enables other colleges to evaluate the results without putting themselves at risk. In the words of a familiar truism, "it's a dirty job...but somebody's got to do it." By taking the lead in a particular area of technology, colleges help one another to define collective technical strategies.

## Risks

Along with the opportunities and possible benefits of technology leadership come risks. Small colleges, in choosing an information technology leadership strategy, must do so with a full assessment of the possible risks — that is, with their eyes wide open. Given the constrained financial environments these institutions face, resources must be invested wisely, and technological applications are but one investment opportunity. Further, leadership is not an all-or-nothing concept; colleges have the choice to lead in some areas and not others.

Underestimating support requirements -- The most fundamental barrier to technology leadership is the lack of adequate support staff. A robust infrastructure (e.g., hardware, software, networks), often a central part of a leadership environment, must be supported by substantial staff resources. These are usually difficult to provide when institutional staffing levels are constrained and institutions are trying to find ways to reduce operating costs. Institutions commonly focus on the creation rather than the maintenance and support of a campus infrastructure, since this is generally what foundations and vendors will fund. Seeking "soft" funding for leadership activities can encourage institutions to think of technology acquisitions as "one-time" expenditures. Vendors, unfortunately, encourage this thinking, since they are generally interested in the short-term promotion of their most recent products by the institution. The immediate result is often large infusions of hardware and software to campuses, with only short-term support from vendor personnel. The end result can be disappointment when continuing staffing needs become apparent.

Infrastructure needs are also driven by factors outside of the institution's control. For example, the release of a new version of an operating system may create broad incompatibilities in the computing environments of colleges and universities. While ultimately, these changes may be beneficial to the institution, short-term problems can result. Since much of the new hardware (and related software) is ordered by colleges during the summer months, support staffs are forced to scramble to prepare for the arrival of machines that will not work with existing software applications and network operating systems. In many cases, institutions that standardize on a particular operating system to reduce costs have to deal with major problems just when an academic year is about to begin. The result is serious, sometimes overwhelming stress on support staff.

Finally, corporate mergers and takeovers, which have accelerated in recent years, can cause further instability in support costs. Institutions that make major investments in leading-edge hardware and software can find a company upon which they rely taken over by another company or out of business entirely. The result can be a significant degradation or elimination of support.

Haves and have-nots – Targeted and substantial investments in technology leadership in one area of the college can create internal tensions if other areas do not feel well served. For example, technology leadership in the modern languages can create campus problems, if other areas, such as the humanities, do not have adequate support for basic operations such as Web browsing or electronic mail.

Automation and cultural change – A common risk of using information technologies to improve efficiency is that the focus will be on automation rather than redesign. That is, instead of analyzing administrative processes to make them simpler, more efficient, or more cost-effective, emphasis is placed on using technology merely to speed up existing procedures without considering their real usefulness.

Further, any effort to improve efficiency will result in cultural change. For example, using electronic mail and bulletin boards to enhance and simplify communication on campus requires participation by the entire community if full benefits are to be achieved. Some individuals will see this kind of change as undesirable, resulting in a less "personal" approach to providing educational services. Change is a disorienting process for many, and cultural change, especially at small institutions with long academic traditions, is particularly difficult. Managing that change carefully must be a primary consideration for institutions attempting to be technology leaders. If handled badly, such changes can result in a backlash that could seriously impede future technology innovations.

Marginal investments – Small colleges already have many of the characteristics of the ideal learning environment for students. In particular, these institutions provide small classes, opportunities for frequent and substantive interactions between faculty and students, opportunities for all students to be involved in co-curricular activities which complement classroom learning, and a variety of support services to assist student learning. These are among the most important reasons why students and their parents are attracted to these institutions. Applications of technology can provide opportunities to further enhance these characteristics. However, equating instructional excellence with information technology leadership is risky. The fundamental decision an institution must make is which areas of technology leadership are likely to improve the campus learning environment.

## Some Final Thoughts

The competition for students among higher education institutions is fierce, and institutions have to balance their investments between technology and competing interests. Among these interests are: financial aid for attracting a diverse student body; improving salaries to attract the most gifted teachers, scholars, and support staff; creating an attractive social environment; and renovation or replacement of physical plant facilities to provide modern learning environments. While it is true that technology investments, at some level, are necessary to provide the tools necessary for students to be prepared for life beyond college, decisions about which college to attend are far more idiosyncratic than analytical. A focus on technology leadership beyond a certain point may not be as important as other investments. It is well known, for example, that the quality of a student tour guide, interactions with faculty while visiting a campus, the social climate on a campus, and the sense of whether the student "fits" at the institution play major roles in the student's selection of a college. While a certain level of institutional technological sophistication is expected, and perhaps even sought, it is not the ultimate determining factor.

Major investments in becoming a technology leader must therefore be weighed carefully against the backdrop of other institutional priorities. Not every small college can or should be a technology leader and those that strive for technology leadership should bear in mind that being a leader is best pursued by excelling in a particular area (or areas), not by attempting to conquer every possible technological frontier. In the end, however, small colleges must seek leadership from within their ranks if they are to help one another find solutions to technological problems.

# Strategic Planning across Multiple Organizations: Community Colleges MIS Consortium and the Central Oregon University Center

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## Abstract

Technology expands both the need for and the practice of collaboration across institutional boundaries. Strategic planning for key concepts--shared values, common vision, and future-directed strategic intents--are even more complete when multiple organizations plan together. The technological elements can be adressed at least partially with technology; however, the human and political factors most be carefully attended or the process goes nowhere.

In these papers, Dr. Brown lays out fundamental principles of strategic planning that apply to collaborative endeavors, Dr. Romero discusses the strategic planning issues and outcomes of the California Community College Management Information System Consortium, and Dr. Markwood describes the context, planning, and implementation of the emerging Central Oregon University Center, which delivers bachelor's, master's, and professional degree programs from other Oregon institutions.

# Planning and Collaboration
# Engaging Multiple Institutions in a Shared Vision
## A Case Study

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Managing and leading a multiple institution collaborative requires greater flexibility in strategic planning efforts. Political realities as well as output goals must be kept constantly in balance in order to succeed. This case study describes a collaborative venture involving nine California Community College districts at the inception of the project. All original districts are still involved and one additional California district has joined the Consortium.
More recently, an Oregon Community College district joined the Consortium.

# COMMUNITY COLLEGE MIS CONSORTIUM

## INTRODUCTION

Unlike the University Center, the MIS Consortium has one shared vision upon which every district in the collaboration agrees: To develop an integrated MIS package for the member community colleges. Developed by users to meet user's needs, the software will run on the various platforms and systems of the member districts.

## PLANNING AND COLLABORATION

Planning by the Consortium has been advanced by the common vision we share. District Chief Information Systems Officers have been our primary environmental scanners as they looked for hardware and software developments in the field, and as they evaluated potential commercial partners. Consortium Board sub-committees have also formed, as needed, to plan and redirect efforts. The Consortium has focused on mutual goals and negotiated agreement on process. I intend to focus on the political realities of multiple institution collaboration and the team learning which must occur if an initiative is to be successful.

Collaborative principles under which we function have included: discussion among co-equals at multiple levels of each institution and in the various consortium work groups, reaching consensus on development and implementation strategies--probably the most extensive of these has been the agreement reached regarding the functional requirements of the software (a copy of which is available for review for those of you who might be interested), and the respect which has evolved among colleagues working on the project. One major issue which required considerable conversation was the work style difference between contract employees and district loaned staff.

## BALANCING POLITICAL DIFFERENCES

But the most challenging and important planning and collaboration factors have been the political needs and differences in culture of each district. Managing these differences in perception and in expressed needs at every level of the collaboration has become our most essential task. The willingness of each district to stay involved as well as the efficiency with which our products are generated is influenced by our response to political situations within the districts.

To put the process in Peter Senge's words, the need to map our mental model of the "how" requires team learning at a variety of levels.[1] For the Consortium, this has meant sifting through the input of many teams in addition to the obvious joint powers agency formed by the 10 districts. Each team operates within its own dynamics.

At the most fundamental level is the team of CEO and District Board. Over our four years in history, the CEO and Board of each district has struggled with issues of commitment and staying the course. None of us anticipated the length of time and the complexity to be addressed in meeting our goal.

For small districts the issues are often those surrounding commitment of significant resources when

[1] Peter M. Senge, The Fifth Discipline (New York: Doubleday, 1990) p. 188.6

they do not benefit from economies of scale. The advantage is that by joining the Consortium they stand to gain from the collaborative efforts with large districts. For the large districts, the question has often been whether they could more easily (with less complexity) achieve the goal on their own given the large sums of money they are committing to the project. The advantage has been that in pooling their resources and developing a product with transportability, Consortium members might recover their investment by making their product available to different sized institutions operating with different hardware.

One collaborative challenge has been identifying and responding to the needs of each district in order to keep the project afloat. Thus, at times we have shifted the priority regarding which modules should come out of development first in order to address a pressing need of one or two districts. At other times the Board has struggled to define the scope of work. At one time strong marketing and promotion of the anticipated product was seen as a way to ensure a return on our investment. Ultimately, the Board held a retreat and decided unanimously that our goal was first to develop a product which met the member district's needs and the product's marketable potential would be determined later.

Another challenge for the Board has been as arbitrator for the other work groups on the project. At the Chief Information Systems Officer level the mapping has involved reaching agreement about compatible platforms, analysis of different systems in use, and consensus about the most flexible yet serviceable platform on which to build the system. Each CISO obviously comes to the table with his or her own commitment to products and equipment which he or she helped select and having convinced others at his or her own district of the benefits of his or her selection. Now those decisions must be modified.

At the staff levels of the SCG and the Design Teams, other issues of personal commitment to existing processes, hardware, and software have had to be overcome. The resistance to changing dynamics is most active at this level.

Staff changes, especially at the CEO's level, have required a continual process of re-commitment to the concept and the agency. Of the original CEOs, only four remain.

## TEAM LEARNING

Another major element of both strategic planning and collaboration involves team learning and the need to distinguish between dialogue and discussion. Our inclination in higher education, and in this project as well, has been to move directly into discussion with its deliberation of pros and cons of the action to be taken. What we have learned more slowly and more painfully has been the need to stop, step back, and engage in dialogue. Again, Peter Senge's model is instructive. As a key to team learning, Senge describes dialogue as a process where one suspends one's assumptions and participates in conversation as a colleague, where the process of thinking through everyone's assumptions and ideas is more important than taking a stand and defending it as one does in discussion[2]. For the Consortium Board, this has become an important part of our retreats. Senge's requirement that all participate as colleagues has not been problematic but with a roomful of action oriented, action generating, CEOs having to put our own needs and agenda aside to frame and redirect the larger picture has been a learning process. The success of our efforts is evident

[2]Peter M. Senge, The Fifth Discipline (New York: Doubleday, 1990) pp. 238-243.

in our accomplishments to date. This team learning process is repeated in each district over and over again as different issues are raised at different levels of each institution and with different work groups.

## FLEXIBILITY

Finally, the need for flexibility cannot be overemphasized. Any major collaboration takes time and plans must be constantly re-assessed and modified to fit unanticipated complexities. Altering original plans, however, is difficult with multiple constituencies because each sub-set is also responding to its own constituency issues. Often we have yearned for the simpler process of being an independent software development business without the structures which frame our discussions and inhibit our dialogue. Ultimately, however, the Consortium is an example of an incredibly successful collaboration and of what is possible when the goal is common and the players' commitment to the goal allows them to make just-in-time changes to meet that goal.

The lessons we have learned include:

1. To be effective a collaborative planning effort must take into account the political agendas of all members.

2. The collaboration will only be successful if trust and flexibility exist and the project can make changes to accommodate the needs of a partner without losing sight of the common goal.

3. A forum must exist to resolve conflicts as they arise.

4. Periodic time must be set aside to evaluate progress, redirect efforts, ensure partners renew their commitment to the goal, and celebrate success.

Strategic planning principles can help but I would end by saying that collaborative ventures are not for the faint of heart.

# Strategic Planning And Collaboration
## A Case Study

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This brief paper attempts to make a few significant points about Strategic Planning and the process of Collaboration. It outlines a series of questions to be used in setting ground rules for collaboration as well as a set of landmines to avoid.

# STRATEGIC PLANNING AND COLLABORATION

## STRATEGIC PLANNING

This brief paper attempts to make a few significant points about Strategic Planning and the process of Collaboration. Strategic planning has been touted as one of the essentia tools to assist organizations adapt to changed conditions. There is no doubt that strategic planning is a useful and a powerful tool for helping people tap into their dreams and values and move to a higher level of motivation and insight. The process, however, is not a "magic bullet" and the effectiveness of the process depends largely on the skills of individuals involved and the process which is designed and utilized.

1 Many believe the effort of strategic planning ends with the development of the vision, mission, strategic goals or other formats that are used. What is often overlooked is the need for the development of an implementation plan which translates the strategic plan to the reality of the operations and tasks that are essential for the attainment of the strategic plan.

2 Attainment of an implementation/strategic plan requires ongoing monitoring and attention. Many boards, executives and managers complete the plan and assume it will happen. Strategic planning requires new belief systems, new ways of thinking and new ways of behaving. Staff and policy groups must view policies, decisions and behaviors through the glasses provided by the directions of the strategic plan. Policies, decisions and behaviors must be made with reference to their ability to support the strategic directions.

3 Strategic planning must be an ongoing process. Not only should progress be monitored, problems identified and considered, but also re-evaluated in terms of the strategic directions in the original plan. When necessary, the plan should be adapted or modified in light of new information and levels of progress.

4 Strategic planning must be developed and implemented in an open spirit of participation and ownership. Too often, one or a few leaders push a plan without involving key persons and maintaining the understanding of the stakeholders in the organization. Collaboration is the result of shared beliefs, motivations and values. When these are not maintained, support and motivation for implementing the plan diminishes.

## COLLABORATION

Cooperation, in which partners agree to work together to meet their individual goals without substantially changing the services they provide or the rules and regulations governing their institutions, is not enough. Collaboration partners share a vision, establish common goals, and agree to use their power to achieve them, commit resources and willingly alter existing policies to meet the common goal.

5 **Establishing Shared Leadership**

A collaborative is most effective when all partners exercise leadership. Partners work as equals rather than dominating those they perceive as less powerful.

6 **Setting Ground Rules**

Successful collaboration requires that everyone in the group contributes to and develops a stake in the process. Ground rules can ensure that partners use time wisely, share leadership, and head in the same direction. These rules should cover maintaining communication among partners, operating the collaborative on a day-to-day basis, resolving organizational and personal conflict issues, and planning and conducting meetings. Collaboratives need to decide:

1. Where, when, and how often will partners meet?
2. How will partners share responsibility for organizing and leading the meetings?
3. Who prepares and contributes to the agenda?
4. What rules should guide the dialogue?
5. Will partners make decisions by majority rule or consensus?
6. What can partners do to ensure that decisionmaking occurs inside the group and not behind the scenes?
7. What happens if there is a problem or conflict?
8. How will partners handle logistical arrangements?
9. Under what circumstances should there be a third-party facilitator?

7 **Landmines to Avoid**

1. Waiting to convene a group until everyone is at the table. The enthusiasm of a wisely selected and enthusiastic core group can cool while others are being brought in. Do not waste time!
2. Not taking the time to involve key players who could easily block what the collaborative hopes to do. Whenever possible, try to make allies out of adversaries.
3. Allowing one partner to assume control of the group instead of establishing the expectation of shared leadership. Collaborative power grows when equals share authority and responsibility.
4. Allowing the media or political pressure to direct the collaborative's agenda.
5. Neglecting to reflect periodically on milestones and landmines.
6. Failing to establish clear ground rules.

8 **Developing a Base of Common Knowledge**

In the most effective collaboratives, partners take time to understand each other's systems and explore their differences. Partners with limited knowledge of each other's organizations often rely on stereotypes and misconceptions to fill in the blanks. To avoid misunderstanding, partners must develop a base of common knowledge. This requires learning about each other's services and resources, goals, objectives, organizational cultures, and working constraints. Developing common knowledge also means understanding personal differences and working together to achieve small victories.

9 **Deepening the Collaborative Culture**

To realize the vision of change, the cultures of all the institutions and agencies in the collaborative change. Collaboration becomes a fundamental part of each agency's mission and approach. Leaders committed to collaboration find ways to reward staff who devote time and energy to the collaborative.

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# Strategic Planning in Multiple Institution Settings
# A Case Study

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Collaborations may involve organizations with conflicting long-range agendas and still succeed. Even though the collaborating organizations are headed toward different ultimate goals, there may be sufficient common ground and interest to support a collaborative program that will advance both agendas despite the conflict in ultimate goals. These generalizations about strategic planning arise from my experience as Dean and Director of the Central Oregon University Center. This analysis is presented as a case study of one multiple-organization project and is intended to illustrate a practical approach to strategic planning in multiple institution settings.

# Strategic Planning in Multiple Institution Settings: A Case Study

Richard A. Markwood

## Introduction

Collaborations may involve organizations with conflicting long-range agendas and still succeed. Even though the collaborating organizations are headed toward different ultimate goals, there may be sufficient common ground and interest to support a collaborative program that will advance both agendas despite the conflict in ultimate goals. These generalizations about strategic planning arise from my experience as Dean and Director of the Central Oregon University Center. This analysis is presented as a case study of one multiple-organization project and is intended to illustrate a practical approach to strategic planning in multiple institution settings.

## The Central Oregon University Center

The Central Oregon University Center (University Center) is a partnership which involves (1) the Oregon State System of Higher Education (OSSHE), (2) the Oregon Office of Community College Services (OCCS), and (3) Central Oregon Community College (COCC). The mission of the University Center is to deliver baccalaureate, master's, and professional degree programs to Central Oregon. Those not familiar with geography and climate of the Northwest should know that the rain typical of the coastal Northwest is cooled, converted to snow, and deposited on the Cascades by the east-bound storm systems. This creates the powder skiing on Mount Bachelor (twenty minutes from Bend) widely acknowledged the best in the Northwest gives us a dry and sunny climate east of the Cascades very much like the mountains of Colorado and New Mexico. These same weather patterns, however, also create treacherous and difficult winter driving for travelers heading from Central Oregon to the Willamette Valley where are Eugene, Corvallis, and Portland, Oregon's population centers and the centers of the majority of Oregon's public and private education resources. Two factors create the need for four-year higher education programs in Central Oregon: a rapidly growing population and isolation caused by distance and weather.

The University Center is designed to serve this need by using (1) the facilities of COCC, (2) the technological capacity of Oregon ED-NET, and (3) the educational resources of all of Oregon's institutions of higher education. The University Center motto is "Education by All Means": it employs traveling faculty, community college faculty, adjunct faculty, two-way compressed video and audio, one-way video/two-way audio, computer-based delivery, video taped classes, and multiple combinations of the above.

This mission-oriented description of the University Center, however, neglects a very important political history which comes into play in the strategic planning. Since 1977, perhaps earlier, Central Oregon Community College and its larger community have worked to create a four-year college in Bend. The first four-year degree program opened in 1981, a BA in Business from Linfield College. The next year, 1982, Oregon State University began delivering, and continues to deliver, four-year programs to Central Oregon. Between 1983 and 1986, a committee of prominent citizens in Bend calling themselves the "Education Committee" actively planned for and lobbied the Oregon Legislature and the higher education community for a four-year institution in Bend (1985). These efforts led to the formation of a the Central Oregon Consortium for Higher Education (COCHE) which earned the support of the Fund for the Improvement of Postsecondary Education (FIPSE) between 1989 and 1991. Participating institutions increased. However, COCHE died after the FIPSE money ran out. The University Center is the newest incarnation of this ongoing effort. It was funded in a budget footnote in the Higher Education funding bill of the 1994/95 Biennium by influential Central Oregon legislators expressing their vision they have for higher education in the area. Throughout this fifteen to twenty year history and today, Central Oregon has never wavered in its ambition to become a four-year institution.

**Oregon State System of Higher Education**

However, in the State Capital and in the Willamette Valley the view is different. Even though the "Education Committee" was successful in getting the endorsement of every public four year institution in the state and of two private four-year institutions, the campaign for four-year status was unsuccessful because the Chancellor of the State System, then Bud Davis, opposed it. From his perspective and that of the Board of Higher Education, there could be little hope of funding more institutions when resources were declining and the Oregon tax payers were revolting. A short time after the "Education Committee" lost in this effort, Ballot Measure 5 (November 1990) re-wrote higher education history in Oregon. Measure 5 won voter support because it promised to control and reduce property taxes. But few citizens foresaw the effects of Measure 5 on many state agencies. These effects spread over three funding cycles (six years) have resulted in OSSHE and other state agencies receiving greatly reduced appropriations in each funding cycle. OSSHE as a system has become leaner; institutions have learned to deal with non-formula-based funding; faculty have gone without pay increases; close to 100 programs have been cut; and tuitions have more than doubled. It is no surprise that in this environment there has been little support for creating another four-year institution in Central Oregon.

**Strategic Planning**

OSSHE has responded to these extended budget crises by reinventing itself in many ways. Crises frequently force planning, and planning frequently produces renewal. This has been true in Oregon. The planning product is "Education Unbounded: A Vision of Public Higher Education Serving Oregon in the Year 2010." Although OSSHE did not create the partnership which forms the University Center, and has no enthusiasm for creating another four-year institution, it can nevertheless find within its "Vision of 2010" rationale for supporting the University Center.

From their perspective, the COCC President and Board see the University Center as the means to move COCC toward their long-term goal. They believe the goal can be achieved. In a draft "Vision Concept Paper," they say, "The long-term future for COCC is unlimited and is constrained only by the combined imagination of the Board of Directors and the leadership staff of the College." They list a number of specific statements which are local initiatives consonant with many of the OSSHE 2010 goals. Key phrases in the COCC vision are taken directly from the OSSHE 2010 statement. By employing this common language COCC assures a resonance with OSSHE that demonstrates the visions are synchronous. The potential for conflict in directions--OSSHE on the one hand looking for programmatic alternatives to building new buildings and new campuses, COCC on the other hand not wavering from its long term goal of becoming a four year institution--meet in a vision which maps a common program.

As Director of the University Center, I ask, "Can such a partnership work, or must it be hopelessly politicized?" It can work. The "Vision of 2010" advances several important and relevant agendas: (1) New partnerships--Build collaborations and realize efficiencies resulting from collaboration; (2) Turf-- Systemwide resources will be focused on local, regional and state needs; (3) Seamlessness--Clients will more easily tread the path through the educational systems kindergarten through higher education; (4) Technologies--Institutions and students must have increased access to technologies, and (6) Information--Information access will be made easier.

The University Center addresses these goals as follow

Collaborations--The University Center provides a setting for innovation. For example the COCC English faculty have been approved by Eastern Oregon State College English

Department to deliver all upper-level English courses of the minor for the BA in Multidisciplinary Studies. Secondly, we are working to develop a collaborative Environmental Technology degree program and anticipate that at least one class will meet simultaneously on three campuses (four-year and community) and be taught by a team of three teachers representing each of the three campuses.
Turf--Currently two private colleges, three OSSHE institutions, and the newly independent public Oregon Health Sciences University deliver programs to the University Center. The number of institutions will grow; each new program changes the turf map.
Seamlessness--In the Eastern Oregon State College Multidisciplinary Studies Program, a student can complete an COCC AA degree in two years, complete an Eastern BA degree in four years, and earn a basic license to teach elementary education granted by the Oregon Teacher Standards and Practices Commission (TSPC), all of this at a cost lower than the student would have paid had he/she spent four years at Eastern.
Technologies--The University Center relies on technologies and helps students develop increasing competency in the use of technologies.
Information--University Center is working with two major library collaborative initiatives to support University Center students, Portals (Portland group of libraries who cooperatively purchase data-base access) and ORBIS (a union catalog based on Innovative Interfaces Inc.'s software).

The University Center in its second year this fall enrolled 80.4 FTEs, 392 individual class enrollments and 160 students known to be seeking degrees. These enrollments will increase and each enrollment will help build the case for a four-year institution in Central Oregon. These programmatic activities, strategically define a broad middle ground between competing agendas, serve the visions of both OSSHE and COCC, and thereby advance the agendas of both.

# COMMUNITY COLLEGE MIS CONSORTIUM (CCMISC)

## ORGANIZATION:

1 Originally Nine Districts/14 colleges
2 Now 10 Districts/15 colleges in California and one district in Oregon:
3 Member districts include:

| DISTRICT | ENROLLMENT |
|---|---|
| Butte Community College District | 11,839 |
| Citrus Community College District | 10,000 |
| Coast Community College District | 57,653 |
| Glendale Community College District | 20,232 |
| Los Rios Community College District | 50,484 |
| Marin Community College District | 10,303 |
| Palomar Community College District | 22,845 |
| Sierra Joint Community College District | 14,500* |
| Siskiyou Joint Community College District | 3,013 |
| Yosemite Community College District | 19,232 |
| Central Oregon Community College | 2,500* |
| *New Member 1995 | |

## FUNCTIONAL STRUCTURE:

4 **Joint Powers Agency**
Separate entity from the districts. Established June 13, 1991.

5 **Board of Directors**
Made up of CEOs from each district.

6 **Chief Information Systems Officers Advisory Committee (CISOAC)**
This committee is comprised of the Chief Information Systems Officer from each Member District. They are advisory to the Board and to the Executive Director. The Chair also sits on the Board as an ex officio member. This committee's role is to see that the software being developed meets each district's needs and will function properly in each environment. The Chair of the Steering Committee sits as an ex officio member.

7 **System Coordinating Group (SCG)**
There are four SCGs, one for each area of the system development: Student Services, Administrative Services, Instructional Management and Human Resources. Each group is composed of a second level administrator from the respective area from each District, i.e., a Dean or Vice President. The primary role of these committees is establishing the overall

functionality or capability of the system. They also play major roles in oversight and coordination of Design Team activities and linkages between the various areas.

8 **Design Team**

There are numerous design teams under each SCG. For example, Student Services includes design teams for Admissions, Registration, Matriculation, Grades and Attendance, etc. Each design team is comprised of district staff who are users and area experts. The team of 6-10 are assisted by two Information Systems Analysts who serve as staff to the Consortium. Their role is to refine the system functionality and design the processes.

9 **Steering Committee**

The primary role of the Steering Committee is to oversee and coordinate activities of the SCGs and to represent users interests, if necessary, to the Board. This committee is comprised of the Chairs of the four SCGs, the Chair of the CISOAC, and the Executive Director.

10 **Consortium Staff**

Consortium staff are all the people who are assigned to the project full-time. This includes district staff and contractors. The current complement is 40 people.

11 **Goal**

To design and develop a comprehensive, totally integrated community college management information system which has the following system characteristics:

1open system
2utilizes relational data bases
3client server
4easy to maintain
5graphical user interface (Windows)
6integrated system
7flexible - off the shelf with capacity to customize
8designed by users
9meets industry standards

## SCOPE OF THE PROJECT:

There are 4 major integrated systems:

### *Administrative/Financial*

(11 modules)

*Payroll*
*Purchasing*
*Receiving*
*Facilities Management*
*Fixed Assets*
*Auxiliary Fund Accounting*
*Employee Benefits*
*Accounts Payable*
*Budget & General Ledger*
*Warehouse*
*Accounts Receivables & Fees*

### *Human Resources*

(5 modules)

*Applicant Management*
*Employee Records*
*Position Control*
*Employee Utilization*
*Compensation*

### *Instructional Management*

(2 modules)

*Course & Curriculum/Curriculum Assessment*
*Scheduling*

### *Student Services*

(7 modules)

*Admissions*
*Matriculation*
*Registration*
*Attendance & Grades*
*Academic History*
*Student Services Scheduling*
*Categorical Programs*

## FUNDING BASE:

12 **District Assessment**

Each district is assessed, annually, proportional fees based on the Consortium formula.

The formula includes a fixed amount for administration from each District plus a per head count assessment of the base year enrollment.

13 **District Fair Share**

District Fair Share allocation is an allocation for staffing the project with Information Systems staff. A District's fair share is determined by taking the number of staff needed; at the present time that number is 21; and multiplying it by the percentage of Annual Assessment that a District provides, i.e., if a District's assessment was 20% of the total, their fair share of staffing would be 4 FTE. Therefore, in addition to the Annual Assessment, a district is also responsible for paying the appropriate amount for the number FTE they owe. A District may lend their own district information systems staff in lieu of payment if the staff have the skills needed by the project.

**TIMEFRAME FOR DELIVERY:**

The first module of the software (Applicant Management) is scheduled for delivery November, 1995. Thereafter, software modules will begin to be delivered every 2-3 months. Version 1 of the entire system is scheduled for completion by the end of Fiscal Year 1997-98.

Each module will be pilot tested by selected member districts prior to release to the other districts.

Delivery is scheduled first to member districts but the possibility of making the system available to other districts is being investigated now.

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# Multi-faceted Planning in "REAL" IT

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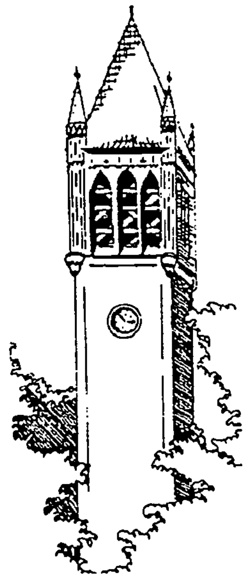


Developing and communicating visionary and practical strategies for information technology efforts is at once inspiring and onerous. In our too-REAL world, the dynamic impacts of rapid technology movement, exponentially growing client expectations, increasing demand on resources, and sheer momentum of change seem to defy the usual concepts involved in planning. Yet we must find ways to chart our courses, meet the ongoing needs of our institutions, lead in overall IT directions, and articulate these efforts.

This paper presents a multi-faceted set of planning ideas, philosophies, and implementations. The ADP Center at Iowa State University uses these to help serve clients in a continuing quality manner. The paper includes an overview of planning objectives, strategic directions, goals for the year 2000, client expectations, organization methods, and implementation priorities.

The on-going plans focus on mission-critical information systems and client service support. Administrative tools are presented to show the practicality of this "Multi-faceted Planning in REAL IT" at ISU.

# Multi-faceted Planning in "REAL" IT

Planning for information technology programs and activities in organizations can be conceptualized in many different abstractions, processes and implementations. If one would ask a random group of people about what planning for IT means, what it should include and how it should happen, surely, the answers would cover a broad range of concepts, focuses, and details. Their responses would reflect the general paradigms of the respondent's view of IT. Many professionals find it hard to plan in the dynamic IT environment. Some information technology professionals feel it may be impossible to plan for the future in IT. There have been recent indications that some CEOs of large IT corporations feel that long-term planing is too formal for IT activities. They suggest that planning can be a hindrance and thus they look at driving out long-term planning to actually make their business more change oriented and successful.

Suggestions that planning may not work in IT presents quite a paradox. Without a plan or focus, our organizations may be going in many directions which can cause a lower success level or actual failure. All organizations and individuals are going somewhere; it is a matter of being a planned or random direction. If it is not driven by planning, then the road may be a lot tougher; valuable resources may be wasted, and effectiveness and efficiencies may be much lower than could be the case with good planning.

> Strategic planning is an active rather than passive activity...

The benefits of strategic planning include a systematic approach for guiding an organization over time through known and unknown changes in its environment with the goal of achieving desired outcomes. This approach confronts major strategic decisions facing an organization. It involves developing a desired future and identifying ways to bring it about through broad principles and concepts. Strategic planning attempts to take advantage of the new and different opportunities of tomorrow while reducing any negative consequences of the unexpected challenges. Strategic planning should be an active rather than passive activity in the approach to continually monitoring an organization's current assessment to keep the organization focused and in line with the changing environment.

Some confuse strategic planning with making future decisions. One can only make decisions for today, but can try to predict the future and develop plans based on present-day factors. This is why plans need to be flexible to allow for the changes over time With an underlying understanding of where an organization wants to go, a plan will be easier to modify as factors change over time.

**Communicate Directions**
A key objective of planning is to communicate to staff and clients the directions and actions for reaching the organization's goals. It is important that the plan be more than a document that sits on a shelf. It should be an active instrument used to define organizational directions as well as to communicate the directions to staff, clients and constituents. Meeting client expectations and providing quality services in all activities is of primary consideration.

A major problem in many organizations is a lack of clear definition of the major functions and goals. This leads to the view that the organization does not know what it is doing and to varying concepts about what they are and should be doing all based on the constituent's viewpoint and knowledge. Well defined and organized planning documents can do much to alleviate these short comings.

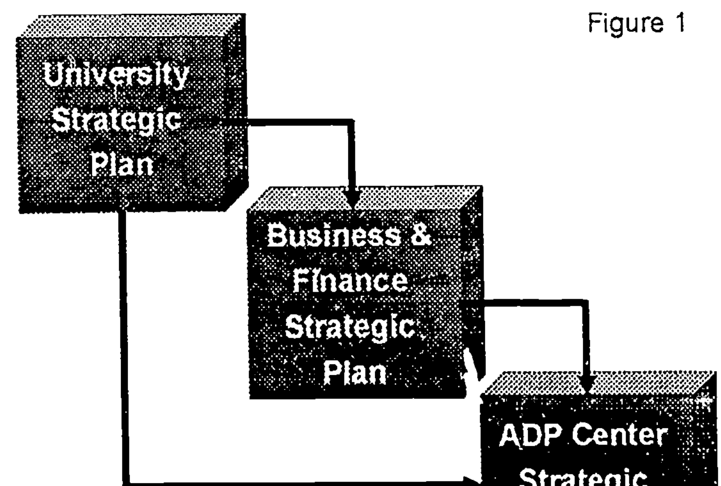
From the time of development through implementation, it is important that the staff feel they have a part in the plan and understand its meaning. This will help staff feel committed to the strategic plan and refer to it in daily activities. The strategic plan should also provide a direction for staff members. In all of their planning activities, annual or daily, the staff can use the plan as a guide to sort out relevant activities.

A strategic plan is also important in working with clients and constituents for communicating the defined priorities and goals. This is aimed at showing that an organization is in control of its efforts and directions to help the constituents feel comfortable about their investment and about the services they receive from the university and the ADP Center.

This principle of communication is inherent in communicating vision, goals and directions to various entities. At ISU, the university, Business & Finance, and ADP Center five year plans were developed by communicating commonality in language, directions, goals, and strategies.

While commonality is important, a single concept of planning or a single plan will not answer varying views. Thus, the ADP Center at Iowa State University has a multi-faceted approach to developing plans and to using tools for monitoring the status of plans. Multi-faceted planning involves planning on various levels, timeframes and situations. This is different than a one-time, static document. Figure 1 shows the three levels of planning at

Figure 1

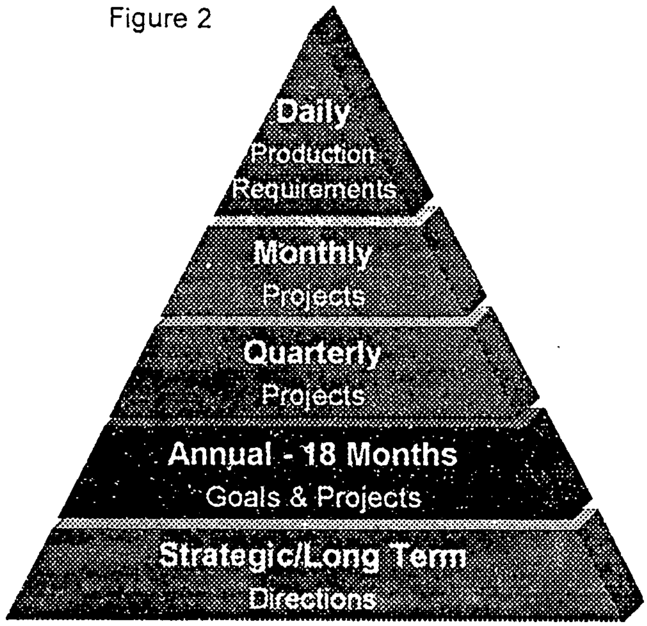


Iowa State University, while figure 2 shows the planning levels in the ADP Center as well as the different timeframes used.

Dynamic activities require on-going interactive use of the planning tools to assure that the intended impact of planning is attained. In this sense, planning has its own life. Planning needs to be dynamic to reflect the various changes in an organization and its environment. As a plan matures, it needs to be flexible to adapt to changes in the environment. If planning is thought of as a one-time document development that cannot change, the plans will not be useful to an organization because the plans will not grow with the organization

**Planning Tools and Levels**
Recognizing the importance of multi-faceted planning, Figure 2 represents the different planning levels and planning timeframes used in the ISU ADP Center. This model also represents the notion that strategic goals are broad and each level beyond that expresses more specific goals. Each of these is further explained.

Figure 2




Strategic/Long Term
Strategic/Long term planning provides a foundation for the direction of where the Center wants to go. This is important in the rapidly changing environment of IT. A **broad set of goals** provides the spectrum for new technologies that may be developed or any changes in the environment.

Annual to 18 Months
This time frame provides direction for goals and **projects** that need to be implemented in order to reach the strategic goals These are generally more defined by budgets, and other resources available

Quarterly
Quarterly planning provides a timeframe that is easier to grasp on a large project This also provides a guideline for how a particular project is progressing. An important aspect in completing a project is to break it down into doable pieces or tasks Through quarterly planning, annual goals can be broken into doable **tasks**.

Monthly
Monthly meetings and interactions are used to monitor progress and other **details** on projects This gives the opportunity to make changes to meet unexpected needs during the quarter.

Daily

Each day presents a specific set of tasks and a new set of plans for the day. These are primarily **production** requirements and answer the basic question, "What do I need to accomplish today and how will I accomplish it?" Properly done, this is much like strategic planning in that it sorts out the important tasks that need to be done in order to reach the goals. Daily goals help attain quarterly goals, quarterly goals help attain annual goals, and annual goals help attain strategic goals.

The remainder of the paper focuses on the development of the current ADP Center Strategic Plan as well as implementation of the plan and multi-faceted tools to monitor the Center's progress toward its strategic goals.

## Developing the Current ADP Center Strategic Plan

### Setting the Stage

A strategic planning group was formed within the ADP Center with the charge of developing a comprehensive ADP Center long-term plan. This group consisted of nine individuals from different areas across the Center. During the first meeting, the group discussed many issues that would help set the stage for future group discussions, activities and decisions. The group took time to discuss the topic of strategic planning. This discussion included what strategic planning is, what the purpose of strategic planning is, why do strategic planning, how will this plan be used, and how will this affect me.

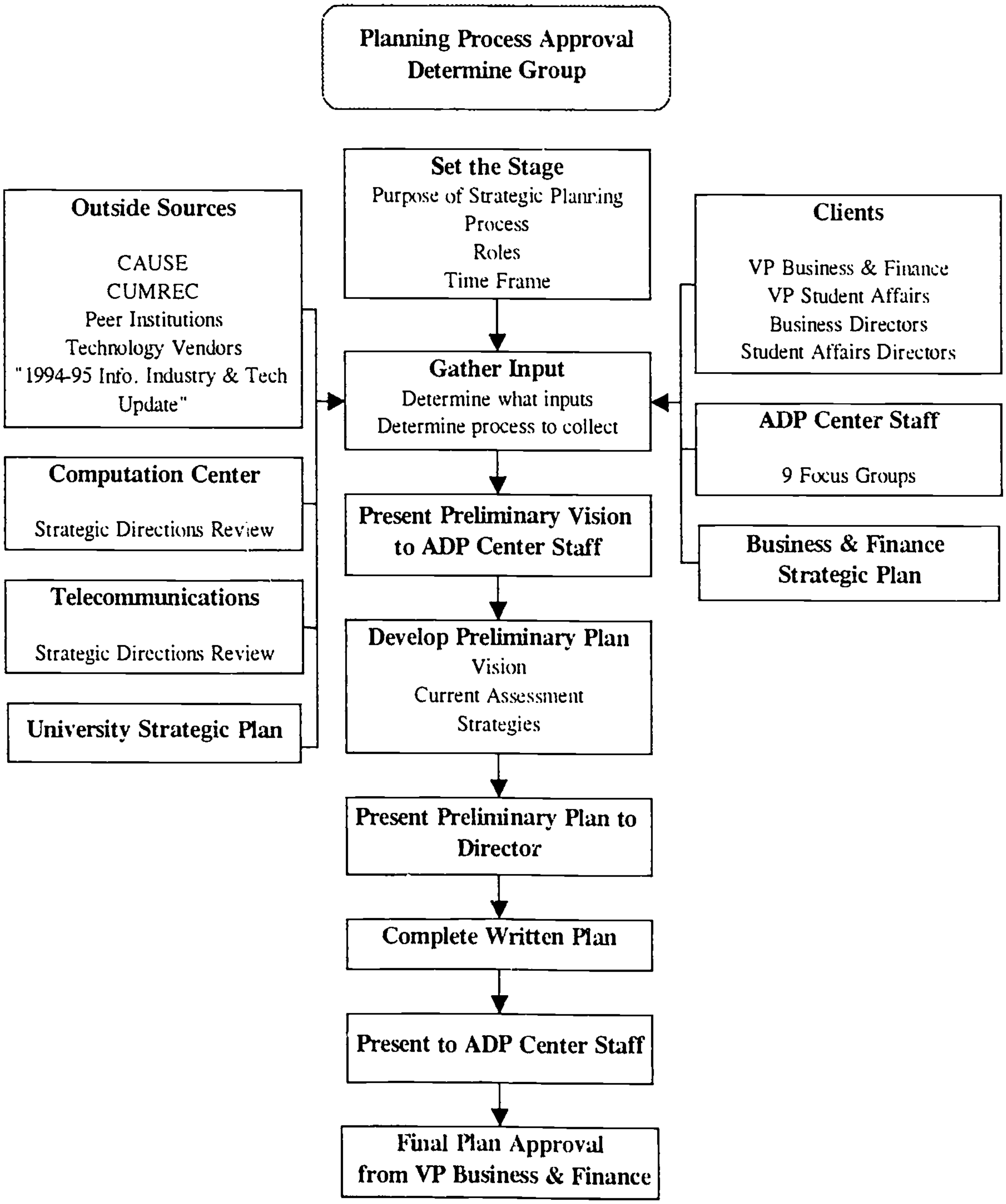
The group discussed their individual roles in developing this plan. Because each person represented an area, they were to act as the representative for that particular area. This meant that individuals were to obtain constant feedback from their team. Another part of role definition was determining the parts of strategic planning for which the group was responsible. It was determined that the group would develop the plan and the ADP Center Administrative Group would be responsible for implementing the plan.

A process was developed to chart the steps involved in developing the plan. This process helped the group stay on track by knowing what needed to be done and the order of the activities. The process, as shown in figure 3, consists of gathering inputs; developing a vision, current assessment, and strategies; and writing a final report.

Another critical issue that needed to be decided was the timeframe for which we were planning. Since the information technology industry is constantly changing at an increasing rate, the group had to determine a reasonable timeframe to project. The group felt a ten year timeframe was too long and would be very hard to project. One to two years would be easier to predict, but the group felt that this planning was more like project planning and not planning for the future Therefore, five years seemed like an appropriate timeframe to project.

Figure 3

# Administrative Data Processing Center Administrative Information Systems Technology Planning Process



**Inputs**

The strategic planning group discussed the importance of obtaining inputs. Obtaining inputs from various sources would involve more people. This involvement can create an interest in the future of the Center as well as create buy-in and commitment to the final plan. It was decided that we should get as much input as practically feasible.

The group then discussed potential inputs for the planning process. The group brainstormed a list of areas to collect information and processes for collecting the information. The group decided to get input from the ADP Center staff, but thought it would be valuable to give the staff some background before asking them for input. "Discovering the Future: The Business of Paradigms," video was shown in several staff seminars in order to help the staff think about breakthrough visioning ideas for the year 2000.

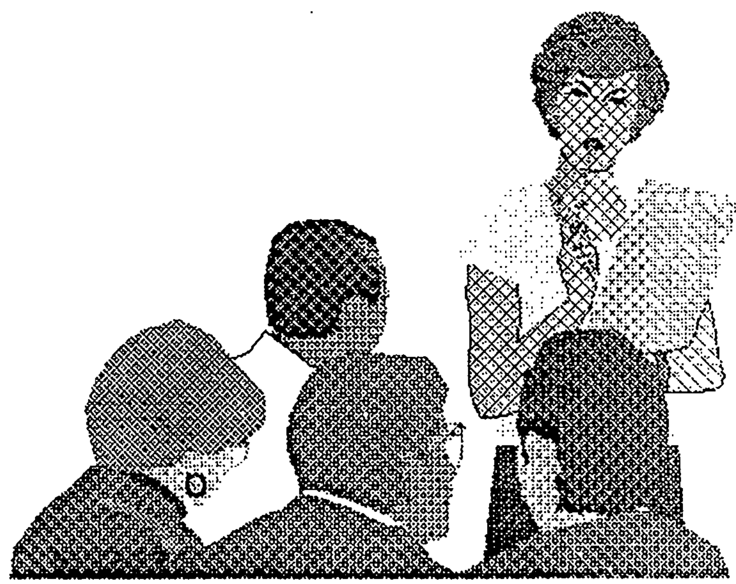
The strategic planning group held nine focus group meetings wherein staff were asked for input on two questions:

"Where do we (as an ADP Center) want to be in the year 2000?"

"What is the current assessment of the ADP Center?"

The SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis was used to analyze our current assessment. Strengths and Weaknesses examine internal factors such as structure, culture, and resources (people, dollars, space, technology, tools). Opportunities and Threats examine external factors such as economic, demographic, political-legal, social, and technology.

Additional focus groups were conducted with the university Business & Finance Directors and the Student Affairs Directors. Similar input was also obtained from the Vice Presidents for Business & Finance and Student Affairs.

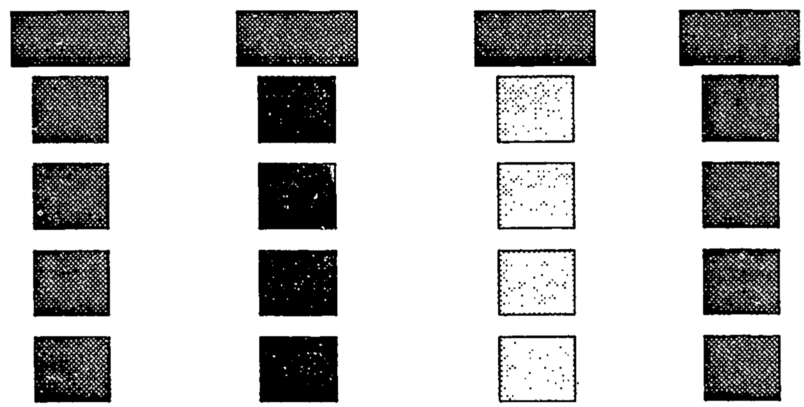


Since the ADP Center works closely with other technology providers on campus, the group obtained inputs from the Computation Center and Telecommunications Department regarding their strategic directions.

The group also obtained valuable inputs from various outside sources, such as publications from CAUSE and CUMREC that focused on where other institutions are heading. Various articles from vendors and other information technology publications were passed among the group members to make notes of important issues for the group to consider in developing the Center's plan. Another publication that was helpful to the group was the "1994-95 Information Industry and Technology Update," published by IDC. This publication predicted future directions in different areas of information technology, such as systems software, office information, client/server, etc.

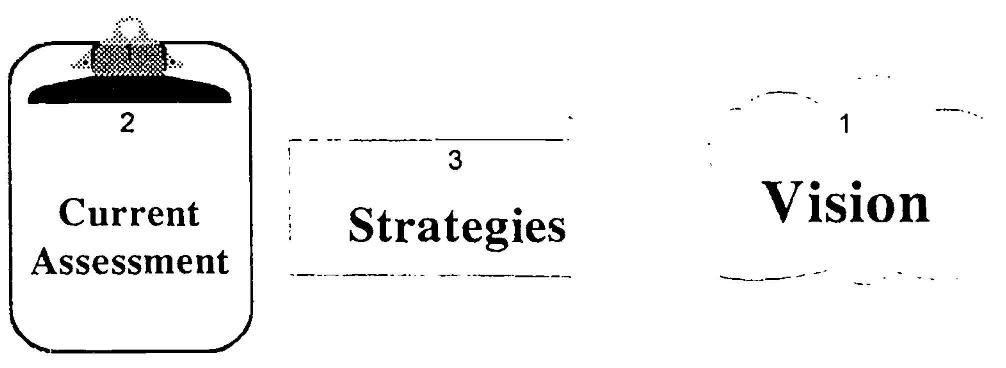
The ADP Center developed its strategic plan concurrent with the development of the university strategic plan and the Business & Finance strategic plan. These emerging plans were also used as inputs to the ADP Center strategic plan.

**Sorting**
Next, came the task of trying to sort all of the inputs into meaningful information. This was a large task considering the group collected 264 vision responses and 220 SWOT responses from the staff focus groups alone.



The group used an affinity diagram to sort like ideas into categories. Using this tool, a group distributes all the ideas on a table. The group can also use Post-It™Notes and place the ideas on a wall. Next, the group members <u>silently</u> sort the ideas into categories with similar ideas. Once the process has stopped, the group discusses the categories and develops header cards for each category, representing the central idea in each category.

**Plan Development**
To develop the Center's Strategic Plan, the group used the process shown in the diagram below. This process included developing a vision, a current assessment, and finally, a set of strategies. These steps are explained below.



**Vision**
The affinity diagramming process led the ADP Center Strategic Planning Group to five major goals. The group developed the vision by describing the goals envisioned for the year 2000. The vision was developed first in order to avoid any tunnel vision that may occur from current views and habits. This vision was then presented to the staff to provide them with a summary of the inputs as well as to provide initial direction for the plan.

**Current Assessment**
Next, the group assessed the Center's current position, internally (strengths and weaknesses) and externally (opportunities and threats). Once again, the group used the affinity diagramming tool to sort responses in each SWOT area. From the categories and header cards, the group analyzed the results and prepared a current assessment summary.

**Strategies**
Strategies were developed to show the Center's actions needed for getting from where it is today (current assessment) to where it wants to be in the year 2000 (vision). Strategies were developed to link the current position to a goal or vision in the year 2000. The importance of this step is to verify that a particular goal is important and to commit a strategy to reaching that goal. Many times if a plan of action is not developed to complete a goal or task, it will not get done.

**Strategic Goals**
The following describe the five ADP Center Strategic Plan goals for moving toward the year 2000.

**Goal 1: Enhance University-wide Administrative Information Systems and Client-support Services**
Much of what the ADP Center envisions itself accomplishing in the next five years will be built on its established foundation of quality mission-critical business systems, reliable client-server networks, service to clients, high standards, and rapid response time. This foundation has enabled the ADP Center to position itself for change. By using technological advances, multi-platform delivery systems, team building, and reengineering concepts, the ADP Center will use its past as a springboard to propel itself into the next arena of information management.

**Goal 2: Lead in the Development of Effective Partnerships**
While the ADP Center must work with its clients in determining its focus of things it can do well within the resources available, the Center recognizes its responsibilities to a wide range of clients and understands the importance of addressing their needs and concerns. To maintain its effectiveness, the ADP Center must continue to emphasize partnerships between the ADP Center, its clients, and its vendors. Where beneficial partnerships can exist, the Center will need to help build them. Additionally, the Center will need to foster a spirit of cooperation that allows for a high degree of integration and connectivity with other campus agencies that provide IT support. Within this spirit of cooperation, the Center must help reach a consensus about shared duties, spheres of activity, and responsibilities The

ADP Center will need to be a co-leader with its partners in reengineering the university's business processes.

**Goal 3: Expand and Enhance Information Access**
One of the most important goals for the ADP Center will be to build on its established systems and networks to provide integrated access to university information through a coordinated network environment in which the university can conduct its business. The Center will need to work to make technological solutions more user friendly.

**Goal 4: Foster Continued Development of a Quality, Highly Productive Staff**
A critical element in the ADP Center's vision is its concept of what its staff will need to be in the coming years. The ADP Center must encourage the highest aspirations and professional development in its staff members. It must challenge them to seek new knowledge and encourage them to understand new technology and then apply their knowledge in practical situations for the ADP Center's clients.

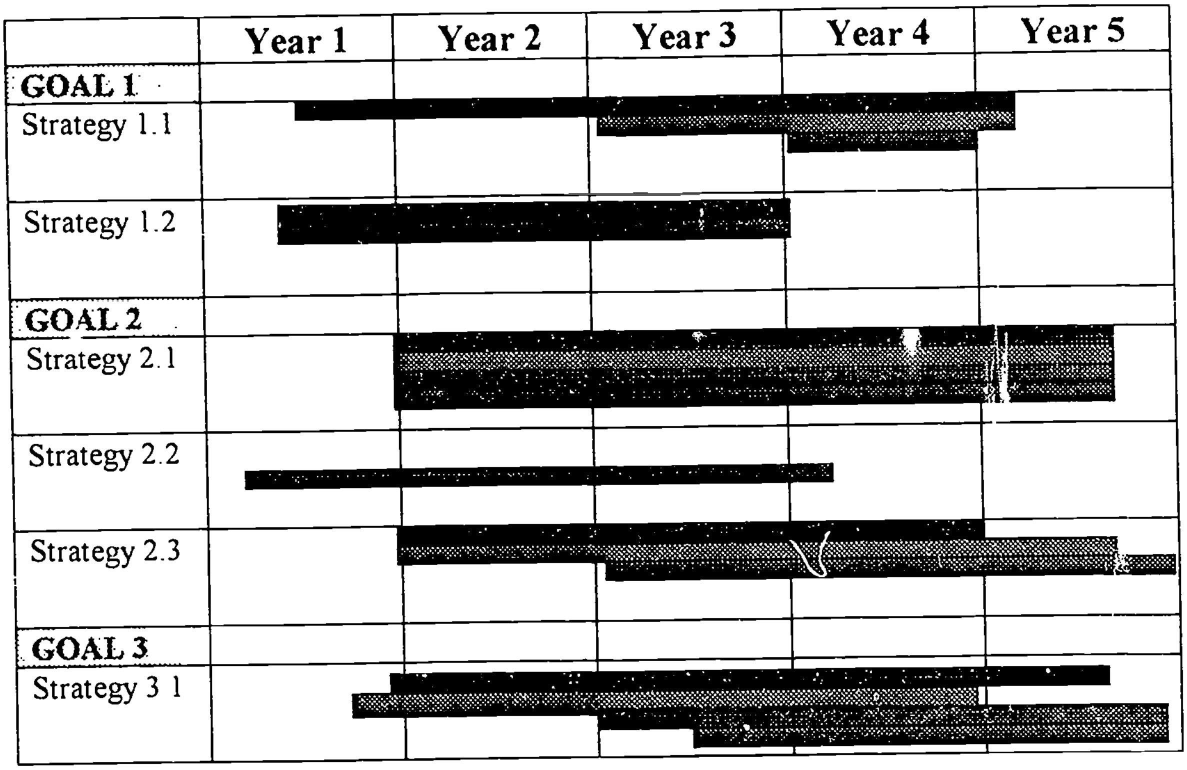
**Goal 5: Promote the Development of Technological Tools and Capabilities**
Iowa State University is a community that values the ability to translate knowledge into action and prizes a willingness to work with experimental technologies, sometimes even before their potential to become part of the mainstream has been recognized. As an integral part of a university community in which technological advances are occurring at an ever increasing rate, the ADP Center must take a leadership role in blending new technologies into the university's administrative information systems. The Center must be poised to take advantage of these advances and to incorporate them into its development and application platforms.

## Implementing the Plan

Planning for and following up on implementing the plan is also very important. Various methods were used to inform the staff about the plan and to start the implementation.

A staff seminar was held to review the purpose of strategic planning, and the process used. A considerable amount of time was spent on communicating the vision and goals for the Center. Examples were given so each team could see how the team fits into the strategic plan.

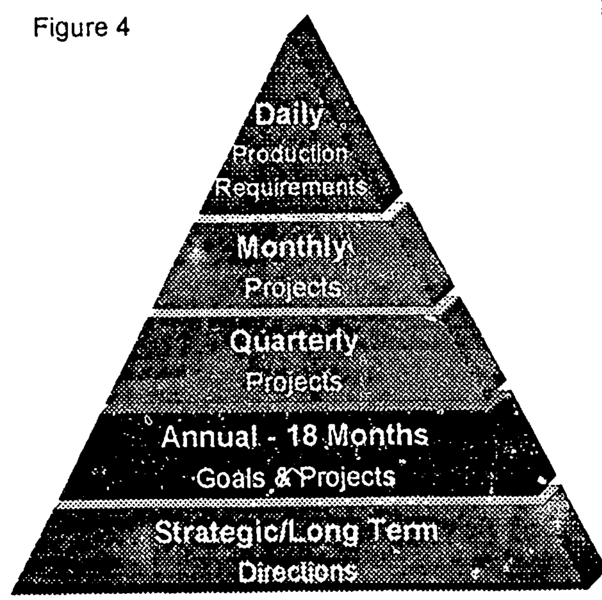
To implement the strategic plan, the Administrative group developed a matrix, as shown on the following page, to help teams focus on goals and strategies relevant to them, to verify all strategies had ownership, and to consider any timeframe sequences. Each bar represents an activity for which a team has participation.




**Planning Tools and Levels**

Figure 4 shows the different planning levels and tools used in the ISU ADP Center. As defined earlier, these tools are used to assist in the implementation and monitoring of the strategic plan

Figure 4




## Conclusion

Planning in a dynamic IT environment can seem like an enormous challenge. By using a well-defined strategic plan as a foundation and multi-faceted planning tools to support strategic activities, an organization can be better prepared for future changes in the IT environment. This should give more assurance that future goals will be met.

# OLAP/EIS Tops Off the Data Warehouse

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## ABSTRACT

On-Line Analytical Processing (OLAP) has emerged as a "break through" technology that can provide the foundation for fast, easy, affordable EIS solutions. OLAP technologies, when integrated with a data warehouse, can aggregate vast amounts of legacy data in both graphic and tabular formats. OLAP technologies feature very fast response, drag-and-drop navigation, point-and-click drill-down/drill-up among levels of detail, and value-based color highlighting for "exception reporting". Using OLAP/EIS solutions, senior managers are able to interactively "browse" hundreds of displays that present a visualization of their institution's business process.

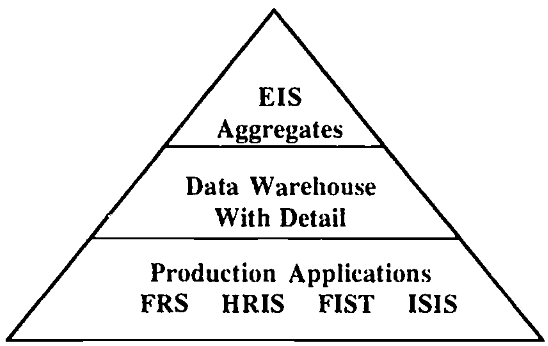
This presentation begins with a quick overview of the University of Rochester's approach to data administration including the development of a multi-gigabyte data warehouse. Distinctions between data querying, reporting, and analysis will be presented. OLAP will be featured as the newest form of these information services. Detailed information and a demonstration will highlight this session.

## Information Technology Architecture: An Overview

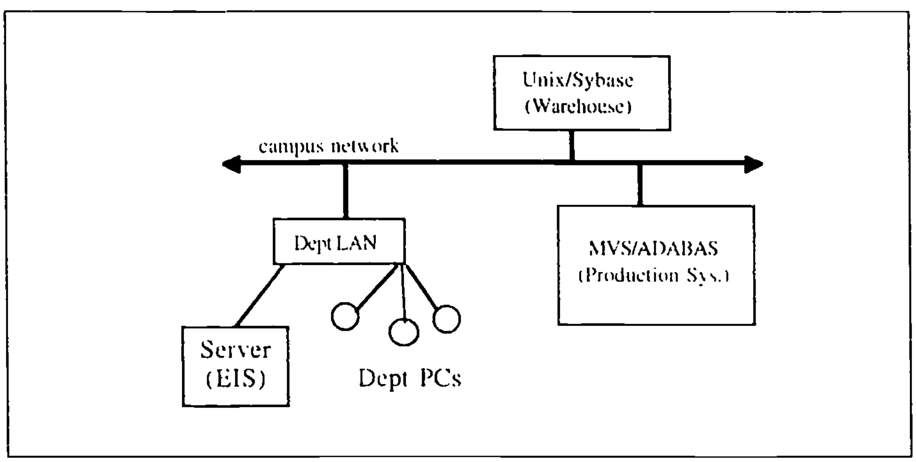
In the Spring of 1991 the University of Rochester's Administrative Computing Services (ACS) launched a major initiative that responded to the growing need for access to information. ACS recognized that in order to both maintain a stable, responsive, secure environment for its complex enterprise-wide applications (financial, human resource, student, development) *and* to begin providing users with fast, easy access to data of university-wide interest that it would have to break away from the concept that all computing and data would be maintained on one large mainframe computer system.

To maintain the production environment while moving ahead with new information retrieval services and technologies, a three-tiered Information Technology Architecture was adopted.

**IT Architecture: Logical View**




**IT Architecture: Physical View**



IT Architecture: Layers Are Critical

| | Data | Access Method | Tools | DBMS | Processors |
|---|---|---|---|---|---|
| Level 1 | Production | Central Staff Using Application Screens and Batch | COBOL, Natural | ADABAS VSAM | IBM/MVS |
| Level 2 | Data Warehouse | Departmental Staff Using Ad-Hoc Query & Report | Access, Impromptu, R&R, Clear Access, Business Objects, GQL, InfoMaker | Sybase SQL Server or MS SQL Server | University Server (UNIX or NT-Server) and Desktop |
| Level 3 | EIS Aggregates | Departmental Staff Using EIS/OLAP Tools | Forest&Trees, Pilot, ESSBase, Brio, PowerPlay | Proprietary and/or SQL Server | Dept. Server and Desktop |

Along with a new architecture, ACS adopted a phased approach to the task of providing fast, easy access to university data.

**Phased Approach To Data Warehouse and EIS**

Phase 1: DO SOMETHING! Develop a warehouse using character-based, terminal-host technologies that could use the Kolm Data Lines that connect most offices.

Phase 2: After ethernet connections were deployed to most desktops, convert to relational and client-server technologies for query/report services.

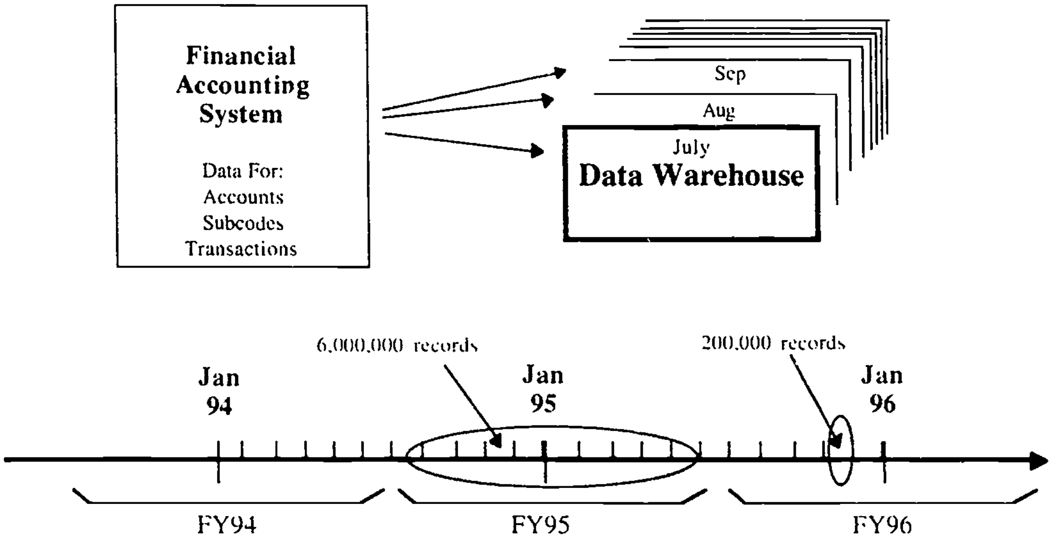
Phase 3: Develop some type of support for senior management.

## Warehouse Application Created

According to the plan, Phase 1 was completed using available technologies and a warehouse was developed with data from the University's centralized financial accounting system. Tools used were Focus report-writer and the Focus data base. The warehouse was designed to hold data for the University's seven schools, hospital, and central administration. The Chart of Accounts contains 8,000 unique 6-digit accounts and 100,000 unique 10-digit account-subcode combinations. Each month a snapshot of the financial system was captured and loaded into the warehouse. Approximately 200,000 records are added each month, six million records per year. The current size of our financial data base in the warehouse is approximately 5 gigabytes.

These concepts are illustrated on the next page.

**5 Gigabyte Data Warehouse Financial Application**
**200,000 Records Added Each Month**




## Conversion to Client-Server

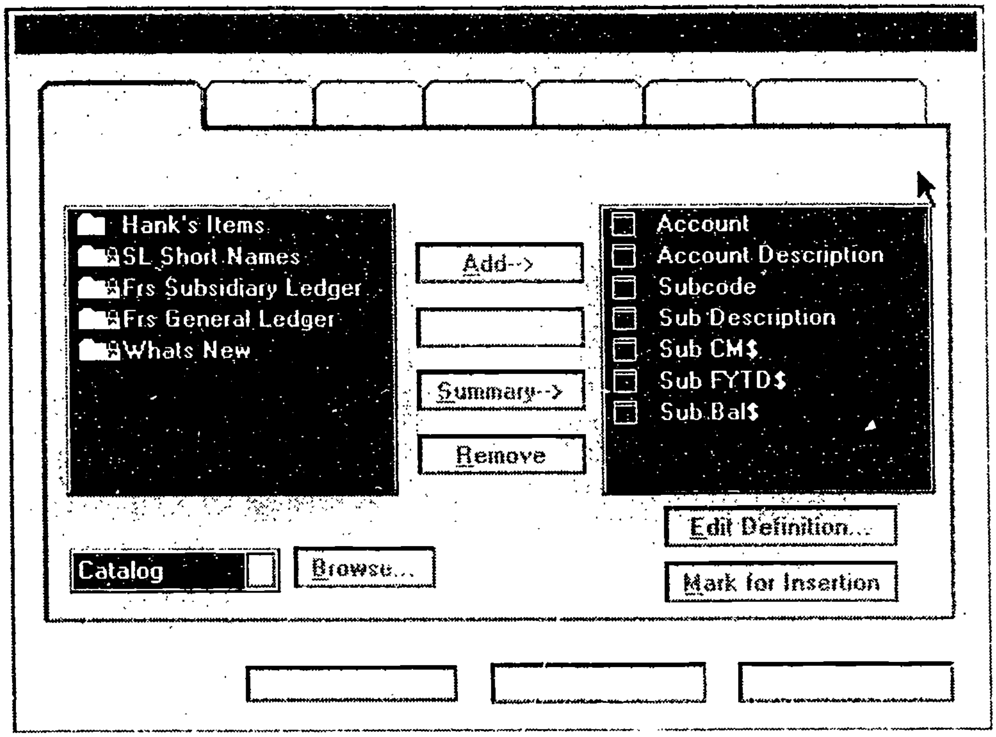
Although Focus was fast and worked well for some people, it was too technical for most office staff to learn. It became an extremely valuable tool for information analysts in central offices such as budget, audit, and financial planning but its learning curve was too difficult for occasional users. It's use as a tool for senior management was not even considered. We accepted this condition as a consequence of the technology and waited patiently for client-server technology to mature.

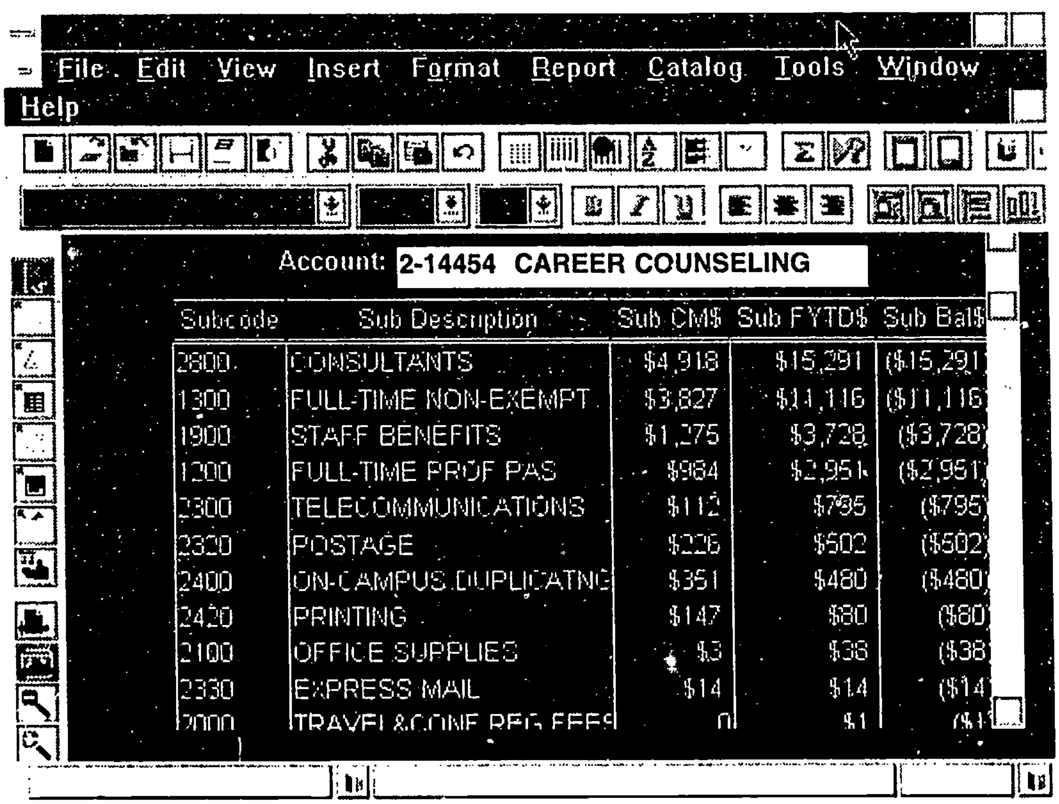
Eventually our campus network expanded and many offices received ethernet connections. Over time we selected Sybase as the relational data base for our warehouse and began converting data from Focus to that platform. As soon as data became available in Sybase we began testing the new toys (i.e. tools) that were available for query and reporting.

Two items became quickly obvious. First, the drag-and-drop, point-and-click, Graphic User Interface (GUI) provided by client-server tools was very attractive, especially when compared to the character-based technologies that were previously installed. Second, performance was slower than with Focus, much slower for some forms of queries.

We spent many weeks experimenting with various tools and forms of data base design ranging from fully normalized to fully denormalized designs. Eventually we settled on a design that gave us good response for most department-level queries. An illustration of a typical query is presented on the next page.

Typical Query Against 5 Gigabyte Data Warehouse (4 second response)



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## Performance: Query/Report vs. Analysis

Response to data retrieval requests varies *widely* depending on at least two major factors; data base design and the type of request submitted. In terms of the data base, we found that a denormalized design with many simple and compound indices works best. One year ago Ralph Kimbal, former President of Red Brick Systems, introduced the notion of a star-schema. Since that time, a number of other articles have appeared praising this design for data warehouse applilcations. Although we have not tested this approach, it certainly looks very interesting.

The type of retrieval requested can also make a *very big* difference in performance. The most common form of a request is one that returns all detail records matching a particular set of conditions. For example, request all subcode records that are year=1996, month=07, account=211706. We refer to these requests as queries or reports. Query/report requests that retrieve data for a specific period of time can run within a few seconds.

Most of the tools that are advertised today are query/report tools. They work best when the user 'filters' (i.e. applies specific conditions) the query which limits the number of records that are retrieved. A small result set is returned to the client workstation where the records are formatted into reports.

In order to expect a timely response, users *must* attach filters to restrict the size of the result set returned from the warehouse. In fact, we encourage new users to 'over filter' their requests to create a small result set until all formatting changes are applied. Once a report is formatted correctly, then remove the excessive filtering to retrieve the desired result.

With the development of data warehouses, another form of request has become very popular, the request for analysis. Analysis requests summarize and aggregate vast amounts of data. Results from analysis requests often appear formatted in a cross-tabular or spreadsheet format. The result set from an analysis query could be *very* large.

Until just recently, if people wanted to produce analysis using client-server technologies, they would often attempt to use query/report tools to perform the task. The very first time that would be atttempted, the performance problem would beccome apparent. Most client-server query/report products don't respond well to large result sets begin returned to the client, *especially* if they have to be further aggregated on the client.

Queries that request data from many months or years can take a *long* time (i.e. hours) to complete. Often Data Base Administrators (DBAs) will be asked to pre-aggregate data into summary tables in order to reduce this retrieval time. Although DBAs need to be able to 'tune' a warehouse to respond to common requests, asking them to out-guess management by creating all of the summary tables they might want is probably not a good use of their time.

An example might help emphasize this important point. The query illustrated on the previous page was very responsive only because we asked for a specific account, month, and year. If we remove the filter for month (i.e. ask for account and subcode data from all months) the response may be very different. The data base optimizer may determine that the number of records that will be returned will be large and so it may change its retrieval mechanism and response time could increase to 3-5 minutes. Summary reports for senior management that pull data for multiple departments or an entire school over a two year period can take 20-40 minutes. University-wide reports that produce multi-year trends can take 1-2 hours to complete!

| Types of Queries/Reports | Speed of Queries/Reports |
|---|---|
| • Simple Lists<br>• Formatted Reports With Sort<br>• Groups With Subtotals<br>• Summary Reports, Crosstabs<br>• Executive Summaries | • One Month, One Dept/Acct (fast)<br>• One Month, All Accts (slower)<br>• All Months, One Act (even slower)<br>• All Months, All Acts (*very* slow)<br>• All Months, All Depts, All Acts (**go to lunch)** |

This is a dissapointing situation. We want to provide management with the ability to leverage the full potential of historical data but that will not happen with standard query/report tools. In fact, we need to limit the number of analysis queries that retrieve historical data because those queries pull down warehouse performance for the entire community. Moving management queries to off hours might work well but our attempts at convincing senior management to work nights and weekends haven't been successful. So ... until we find a way to access vast amounts of historical data in the same fast, easy manner that we query/report data, management will not be able to maximize the value of this valuable resource.

This is where the University of Rochester found itself exactly one year ago. At that time, the only way we thought we would be able to leverage the great value of our historical data would be to extract subsets for specific departments or vice presidents. The plan was to pre-process this data, compress it, aggregate it and then place it on their department server.

Thank goodness we didn't get into that game. OLAP emerged just in time.

## OLAP To The Rescue

In November of 1994, while testing client-server query/report tools, ACS began to hear about a new technology called On-Line Analytical Processing (OLAP). Observing with a casual interest, we were convinced to investigate the new technology after reading an article by Richard Finkelstein titled "Understanding the Need for On-Line Analytical Servers" (see suggested readings at the end of this paper). Several months later, after pursuing several vendors and products, we selected PowerPlay from Cognos for the development of a prototype.

During the Spring of 1995 we began demonstrating PowerPlay to senior management and other IS staff members. Their reactions were all very similar - - spontaneous, short bursts of uncontrolled laughter. They couldn't believe what they were seeing! PowerPlay's OLAP technology was giving us instant access to aggregates from millions of records from our warehouse. The product provided one second response to hundreds of graphic and tabular displays, with drill-down/drill-up between levels of detail and a mouse oriented drag-and-drop, point-and-click interface that was so easy to use, even senior managers could use the product!

Many articles have since been published that explain the features of OLAP, how they work, their costs, and the vendors that have products on the market. A list of several articles that we found to be helpful is presented at the end of this paper.

**How does it work?**

OLAP technology consists of two major components, the server and the client. Typically the server is a multi-user, LAN-based data base that is loaded either from your legacy systems or from your data warehouse. You don't need a data warehouse in order to implement OLAP but if you have historical data, OLAP's visualization capabilities will reveal patterns of your business process that are hidden in the data.

**The Server**

Think of OLAP data bases as multi-dimensional arrays or cubes of data, actually cubes of cubes, capable of holding hundreds of thousands of rows and columns of both text and numbers. The current terminology for these data base servers is Multi-Dimensional Databases (MDDs). The MDDs are loaded from your data source (legacy or warehouse) according to an aggregation model that you define. Fortunately, defining the model and loading the data base can be very easy. For some OLAP products absolutely no programming is required to build the model or to load the data.

**The Client**
The client component for several OLAP products presents a spreadsheet-type interface with *very* special features. Features available in some products include the ability to instantly change the data component of either the x, y, or z dimension of your spreadsheet using drag-and-drop. You can change your display from tabular to any one of various charts including pie, bar, stacked bar, clustered bar, line, or multi-line - - all with one second response using drag-and-drop. Exception highlighting is another very nice feature. This allows your display to dynamically change font, point-size, and color of rows or columns based upon the value of a component of the display. You can also hide rows or columns based on dynamic values.

Instant drill-down/drill-up is a particularly valuable feature. For example, placing your mouse over a school name and double clicking can invoke a drill-down to department-level numbers. Double clicking on a department can take you down to account-level data. At any point you can then jump from one graphic or tabular display to the next, including multi-year displays, each with a one second response time.

**Rapid Development**
As stated above some OLAP products require absolutely no 'programming' in order to define an MDD model or to load the data. At the University of Rochester, the average time required to create a model is 20 minutes. The average time to load an MDD is another 20-40 minutes. Therefore we tell our customers "Once you give us a data file, we will have you paging through graphics within one hour." With such rapid development capabilities it is possible to think of EIS solutions that address a short-term business opportunity. In fact, disposable solutions can be considered. Develop a system, use it for 2-4 weeks and then discard it.

## Interactive Scenario: Create An OLAP Application

At this point in the presentation, based upon our knowledge of typical financial systems, we will simulate the construction of an OLAP application. In the process of constructing this prototype, several fundamental OLAP concepts will become clear, including the concepts of data dimensions, Multi-dimensional Data Base (MDD), hierarchical data models and steps involved in moving data from a warehouse into an OLAP application.

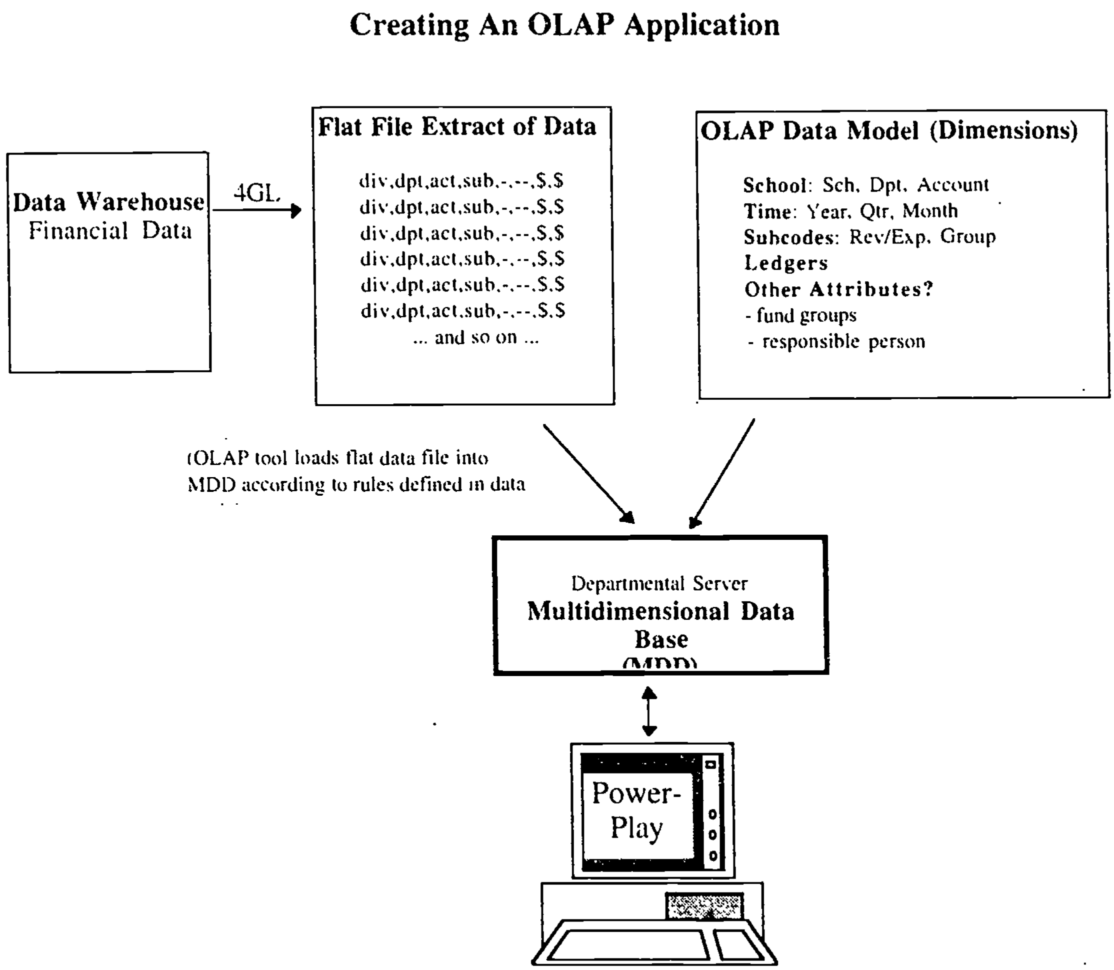
Our objective is to create an OLAP application that will allow management to view a wide variety of spreadsheets and graphic displays of financial data. Management wants to see financial aggregates by year, month, school ,department, account, subcode, ledger, and various other attributes. They need to see dollars and percents sliced-and-diced by those dimensions. We need to extract data from our Financial Accounting System (MVS mainframe) and load it into an OLAP data base located on our departmental server. We need to:

**Identify and Extract Data To Be Used**
Identify what views (dimensions) will be most important.
(create diagrams of typical spreadsheets, graphs)
Identify what data must be extracted to produce those views (dimensions).
Write a 4GL program to extract the data into a large flat, delimited ACII text file.

**Build an OLAP model**
Identify the data dimensions that will be used.
Identify what data items from the extract file will be loaded into what dimensions.
Identify what data items will be measured (added, totaled, summed).

**Load The Application**

Now we are ready for the final step, load the OLAP data base with data from the extracted file according to the model.



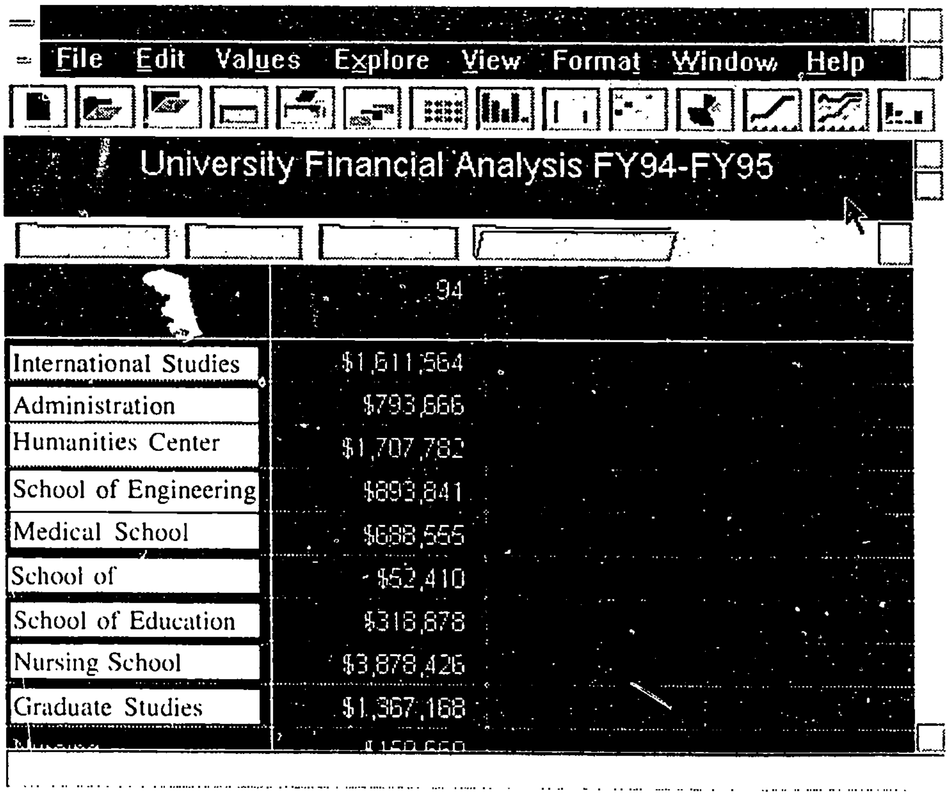
## PowerPlay: An OLAP Tool In Action

Here is an example of an OLAP tool in action, PowerPlay from Cognos. During the live presentation of this paper, many screens will be displayed. Only a few are included in the hard-copy version of this report.

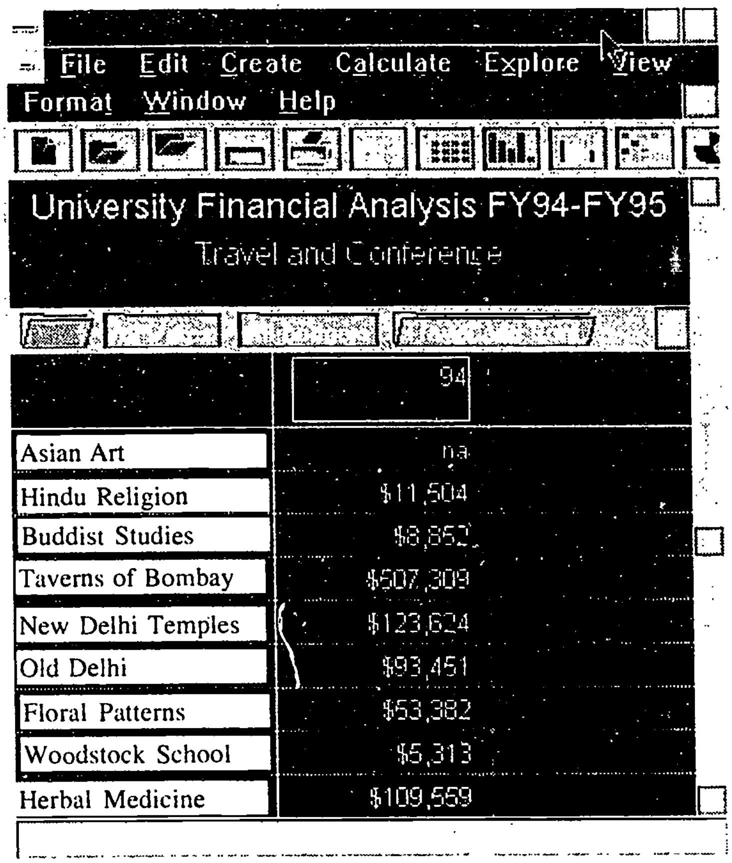
Here is a very brief example of a realistic situation. A senior officer needs to do a quick evaluation of Travel and Conference expenditures. The manager launches PowerPoint, selects an MDD, and begins browsing aggregates.

"Let me look at the University's Travel and Conference expenditures."

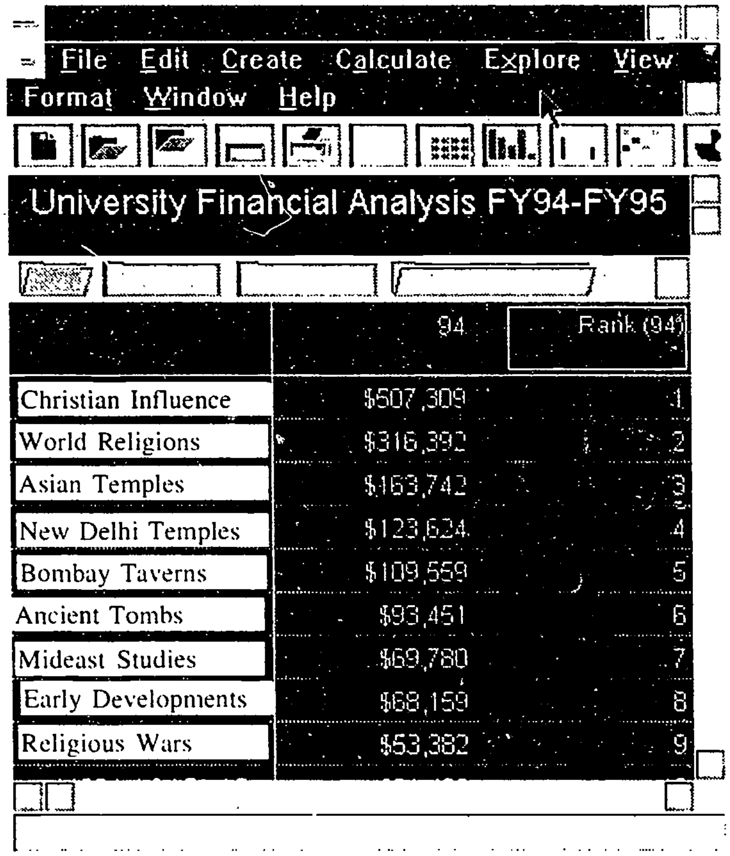
**Travel and Expense By College (one second)**



"Let's take a closer look at the Humanities Center."

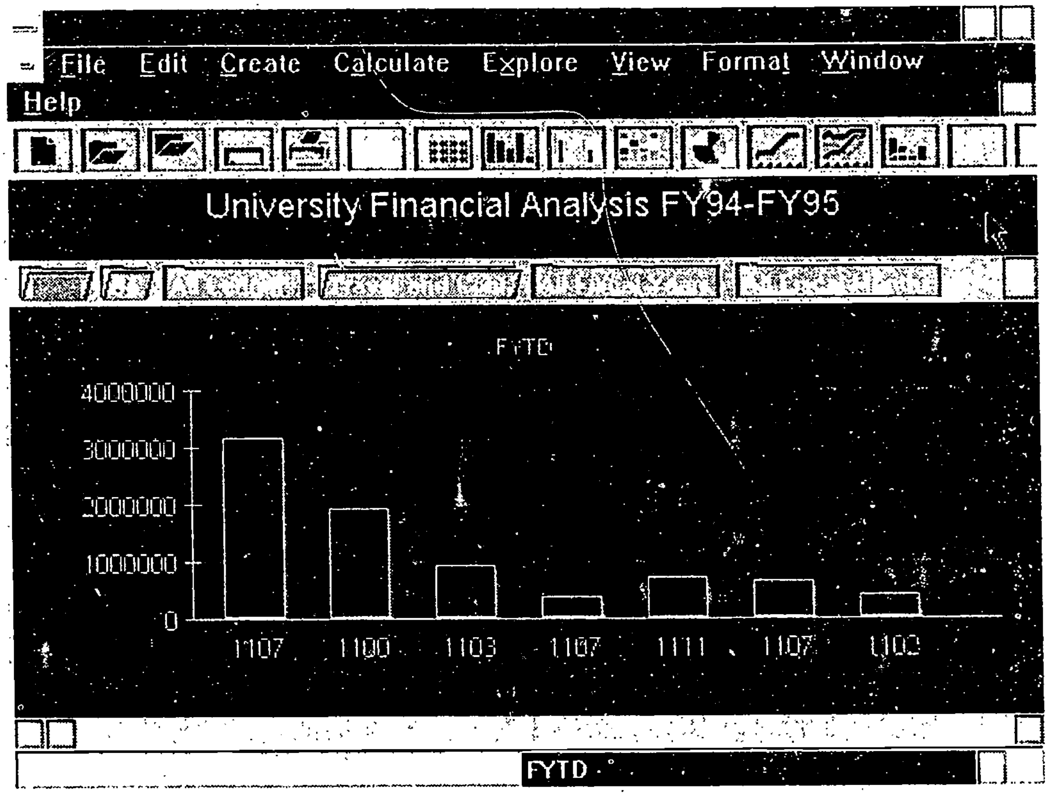


"I wonder which departments are spending the most."

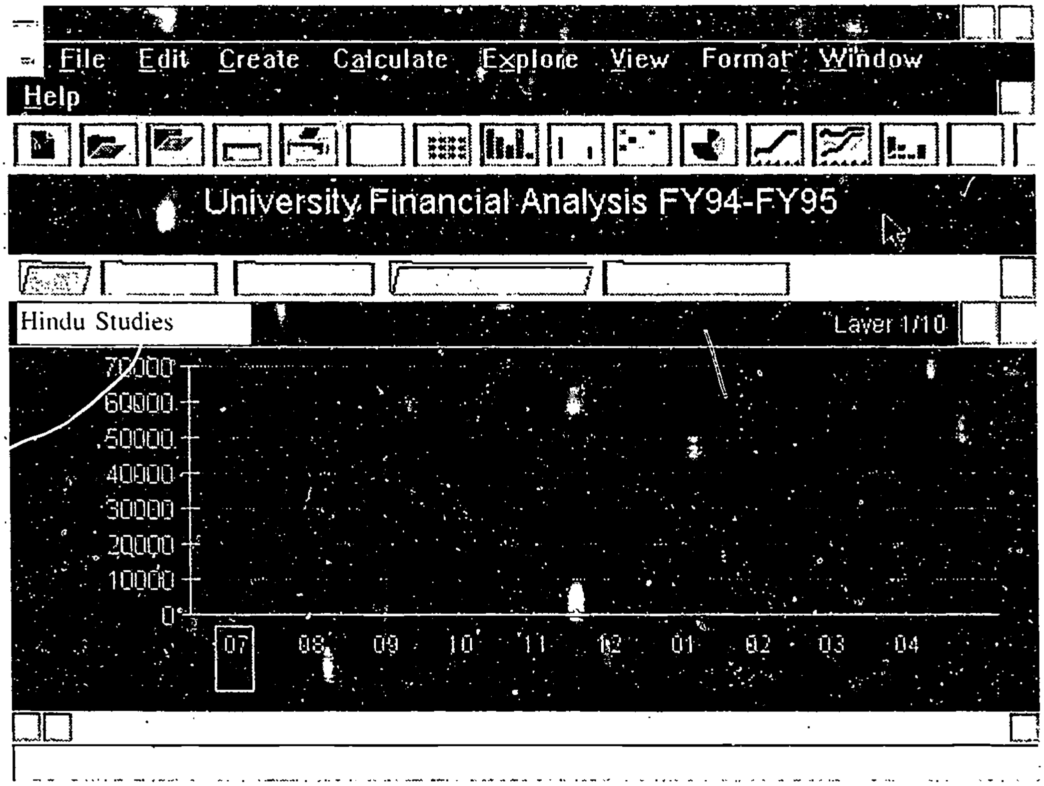



| | 94 | Rank (94) |
|---|---|---|
| Christian Influence | $507,309 | 1 |
| World Religions | $316,392 | 2 |
| Asian Temples | $163,742 | 3 |
| New Delhi Temples | $123,624 | 4 |
| Bombay Taverns | $109,559 | 5 |
| Ancient Tombs | $93,451 | 6 |
| Mideast Studies | $69,780 | 7 |
| Early Developments | $68,159 | 8 |
| Religious Wars | $53,382 | 9 |

"Let's look at this graphically."



"Let's take a look at their spending patterns month by month."




and so on ...

This is an example of the incredibly fast response that OLAP tools provide management. Response is so fast they are able to "browse" aggregates from hundreds of thousands of records. In addition to the instant response, graphic display help them visualize business patterns that are otherwise hidden in their data.

## Conclusion

The information retrieval needs of a large organization can become complex and diverse. Adopting an IT strategy that supports multiple layers of technology and data enables an information systems group to respond to those needs in a manner that is flexible and proactive without endangering the performance and security of mainframe production systems.

The development of an integrated data warehouse may become a cornerstone of such a strategy. The existence of a warehouse allows organizations to retain multiple years of historic data. Standard query/report tools can access that data but performance may be very slow. Even if performance is tolerable, special client tools are needed to provide management with the ability to browse historical data in a fast and easy manner. OLAP technologies appear to be the first affordable solution to this challenge.

OLAP technologies compliment existing query/report tools. They 'top off' the data warehouse in a manner that enables senior management to interact with one of their most valuable resources, information.

## Suggested Readings

1. Arbor Software Corp., "Multi-Dimensional Analysis: Converting Corporate Data into Strategic Information", Sunnyvale, CA, 1994 408-727-5800 (white paper)

2. Dan Bulos, "Comprehensive Guidelines For Evaluating OLAP Servers", DBMS, August 1995, pps 96-102

3. E.F. Codd, S.B.Codd, C.T.Salley; "Providing OLAP (On-Line Analytical Processing) to User Analysts", Sunnyvale, CA, 1994 Arbor Software Corp.; 408-727-5800

4. Richard Finkelstein, "Understanding the Need for On-Line Analytical Servers", Chicago, 1994 Performance Computing Inc.; 312-549-8325

5. ________. "MDD: Database Reaches the Next Dimension." Database Programming Design, April 1995, pp.27-38

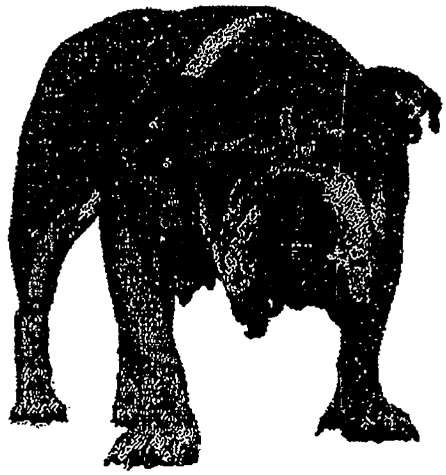
6. Maurice Frank. "A Drill-Down Analysis of Multi-Dimensional Databases." DBMS, July 1994, pp.60-71

7 ________. "The Truth About OLAP." DBMS, August 1995, pps 40-46

8. John F. Rockart & David W. DeLong, "Executive Support Systems", Dow Jones-Irwin, 1988

9. Birgitt Tangermann, "OLAP Product Directory", Data Based Advisor, December 1995, pp 50-53

10. Paul Youngworth, "OLAP Spells Success For Users and Developers", Data Based Advisor, December 1995, pp 38-49



# You CAN Teach an Old Dog New Tricks: Extending Legacy Applications to the New Enterprise Architecture

Nicholas C. Laudato
Dennis J. DeSantis

University of Pittsburgh
Pittsburgh
Pennsylvania

In 1994, a team of faculty and staff at the University of Pittsburgh completed the design of an enterprise-wide information architecture. The architecture provides the blueprint for developing an integrated set of information services, processes, and technologies, enabling significant efficiencies in business and service processes, and facilitating informed decisions concerning information technology expenditures and acquisitions.

Revolutionary in design, the architecture utilizes pattern-based abstraction techniques to enable evolutionary implementation and intelligent use of legacy systems. This presentation addresses the prototype application programs developed to illustrate sample information processing patterns as well as the look and feel of the envisioned architecture. It focuses on the latest and most ambitious of the prototypes, a client/server application that puts a graphical user interface on a character-based legacy application. This "prototype" is currently in use by faculty advisors and staff in five schools, and is being implemented by several others. It allows the legacy system to be integrated with the University's envisioned enterprise-wide information architecture.

# You CAN Teach an Old Dog New Tricks: Extending Legacy Applications to the New Enterprise Architecture

Nicholas C. Laudato and Dennis J. DeSantis
University of Pittsburgh

## Background

The University of Pittsburgh is an independent, nonsectarian, coeducational, public research institution. Founded in 1787, it is a state-related member of the Commonwealth of Pennsylvania System of Higher Education. In addition to the main campus in Pittsburgh, the University operates four regional campuses in Western Pennsylvania. Among its five campuses, the University offers over 400 degree programs, and, during the Fall Term, 1994, enrolled 32,519 students (headcount).

In the fall of 1992, the newly-appointed Senior Vice Chancellor for Business and Finance conceived of an initiative to transform the University into a modern organization where information is viewed as an asset and used to strategic advantage. He selected a senior faculty member from the Department of Information Sciences to design and direct a special project. The project director initiated the *Information Architecture and Process Innovation Project* in February, 1993, with four individuals selected because of their background, knowledge and experience with varied components of the University. The Team defined the following mission:

- Design an architecture for the University Information System (UIS) that will provide a framework for making decisions about information systems and for improving the UIS in the future;
- Establish a methodology for business process reengineering using the UIS; and,
- Develop a plan for migrating from the current systems to the envisioned UIS.

The project team made their final recommendations to the University community in June, 1994. The architecture project is documented in *Reshaping the Enterprise: Building the Next Generation of Information Systems Through Information Architecture and Process Reengineering.*[1]

This paper addresses two important features of the UIS architecture and its implementation: the information processing patterns that are central to defining and evolving the architecture, and the prototype application programs developed to illustrate those patterns. It focuses on the latest and most ambitious of the prototypes, a client/server application that puts a graphical user interface on a character-based legacy application. This "prototype" is currently in use by faculty advisors and staff in five schools, and is being implemented by several others. It allows the legacy system to be integrated with the University's evolving enterprise-wide information architecture.

## Addressing Legacy Systems

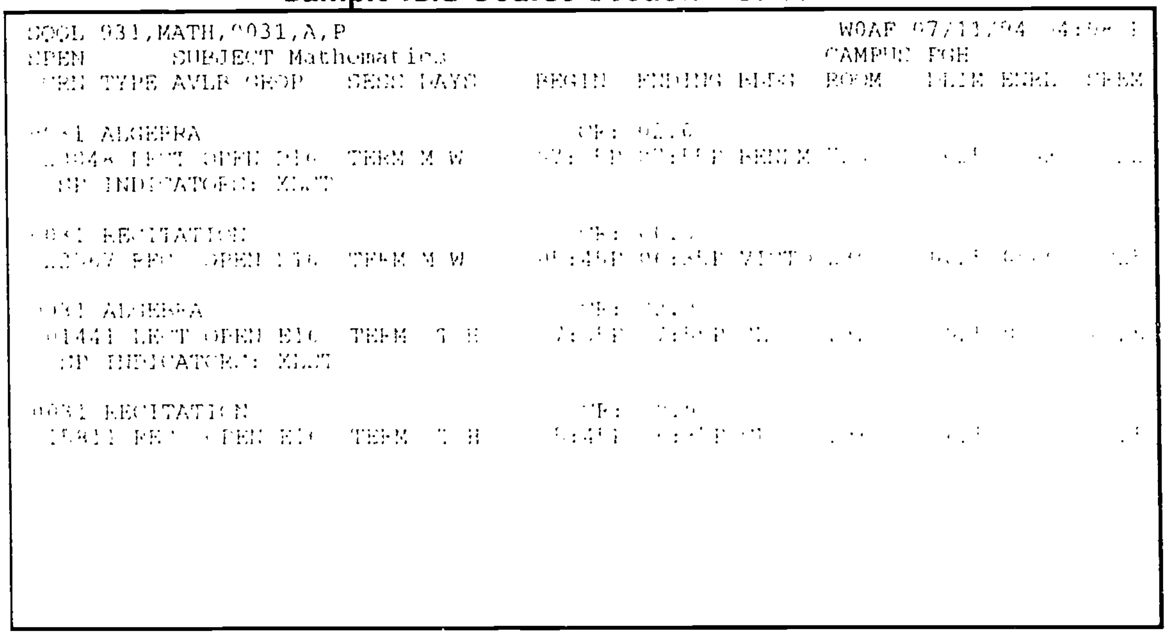
Part of the original motivation for the Information Architecture and Process Innovation Project stemmed from limitations of the University's existing legacy systems. Like most institutions, the University acquired or developed its core business applications over 20 years ago, and implemented them in a centralized IBM mainframe environment. With the explosion of local computing and networking capabilities, individual schools, departments, and administrative units have built local systems to supplement or complement the older central systems. This proliferation of systems has resulted in islands of automation and redundant data.

All of these systems could not be replaced simultaneously, but would have to be addressed in priority order, determined by their importance to the University's mission, their relative state of disrepair, and the relative degree to which they adhere to or contradict the information architecture. Of particular interest was the University's student information system.

The Integrated Student Information System (ISIS) addresses the admissions, financial aid, course, registration, housing, billing, grading, and academic history functions of the University. It feeds the financial, human resources, ID center, and alumni development systems, and is central to the work of the University. ISIS is the newest and best of the University's legacy applications, and works well for its original purpose. It is a character-based application, written in COBOL, that runs in CICS on the University's IBM 3090 mainframe. ISIS is implemented in SUPRA, a quasi-relational, non-SQL compliant database management system from Cincom, Incorporated.

To access ISIS, a user logs into the mainframe via a 3270 terminal session. ISIS transactions are invoked by entering a four-character transaction code, followed by a transaction key. The transaction key specifies parameters for the transaction. For example, the ISIS Course Section List screen is invoked by the "SQQL" transaction code, followed by five parameters: the term code, subject code, course number, availability code, and campus code.

**Sample ISIS Course Section List Screen**




ISIS is not compliant with the newly-designed UIS architecture. Its database is not SQL compliant and it is costly and difficult to access in client/server mode. The ISIS user interface is inconsistent with the architecture, and difficult to navigate for the casual user. The transaction keys, in particular, are difficult for the casual user to remember. One course screen may require the user to specify the academic term and course reference number, while a similar screen may specify that the parameters be entered in an entirely different order, or may require additional fields.

ISIS was designed for the specialist who would use a handful of transactions over and over again each day. For this type of user, the character-based interface is effective and efficient. However, the information needs of the University community have expanded since ISIS was originally designed. For example, academic advisors should have access to their advisees' student records, as well as up-to-the-minute knowledge of what course sections are still available for registration. In many of the University's schools, advising is performed by full-time faculty. As an ISIS user, a faculty member does not match the specialist model.

Compared to the specialist, the average faculty member will have infrequent, sporadic access needs, and may go months between periods of usage. Such users have difficulty retaining the detailed knowledge needed to easily navigate the ISIS screens. If one would compound the idiosyncrasies of the ISIS interface with those of a financial system (faculty often manage research grants), a purchasing system, and a human resources system, the cognitive load required to master several different interfaces quickly becomes a major obstacle to effectively using the information system. In the envisioned information system, the common graphical user interface would resolve this problem.

## Pattern-Based Growth versus the Master Plan Approach

Because of the broad scope of the envisioned University Information System, it was clear that its implementation would have to be phased in over several years. The traditional approach to implementation is to specify a detailed ***master plan***. However, one of the problems inherent in implementing a traditional master plan over a period of years is the rapidly changing nature of the technology itself. Components of the solution become obsolete before the solution is even partially implemented. The monolithic architecture ultimately is abandoned as irrelevant to the changing times. To avoid these problems, the project team eschewed the traditional master plan approach in favor of a ***pattern-based approach*** to building the information architecture.

This methodology was inspired by the Oregon Experiment[2], a unique approach used over the past thirty years in designing the University of Oregon campus. The project team's adaptation of the Oregon Experiment approach recognized many parallels between the architecture of towns and buildings and that of information systems.

In the Oregon approach, a set of six core principles serve to guide the building process through the use of a pattern language. The pattern language describes the detailed patterns for towns and neighborhoods, houses, gardens, and rooms. For example, the Oregon architects noted that "When they have a choice, people will always gravitate to those rooms which have light on two sides, and leave the rooms which are lit only from one side unused and empty[3]." In a master plan approach, this insight would translate to blueprints showing two particular windows in each room on campus. After waves of renovations, and with subsequent designs, the intent and specific implementations will both be lost. With a pattern-based architecture, the "light on two sides of every room" pattern stipulates that the architect "Locate each room so that it has outdoor space outside it on at least two sides, and then place windows in these outdoor walls so that natural light falls into every room from more than one direction." After twenty years, the guideline specified in the pattern language still works, whereas the blueprints are completely obsolete.

## Creation of a Pattern-based Information Architecture

In a pattern-based approach, the information architecture is documented as a set of patterns based on information processing principles. Decisions about developing, modifying, or acquiring components of the architecture are made by evaluating proposals based on their adherence to the specified patterns. The patterns are subject to on-going review and refinement to ensure that they incorporate advancing technology and continue to meet the needs for which they were designed. The information architecture evolves as more and more projects are implemented that comply with its specifications.

The patterns must be communally designed and adopted, and will guide the design of everything in the University Information System. Patterns can be very large and general, as well as very small and specific. Some patterns deal with the behavior of computer interfaces, some with the distribution of data, some with hardware configurations, some with network protocols, and others with data access methods. More specific patterns deal with report formats, application-specific functions, ordering of data on displays, etc.

In a pattern-based approach, the task of articulating the information architecture becomes one of identifying and documenting the information processing patterns that will underlie all information activities in the envisioned University Information System. This is not a one-time task, but a dynamic, evolutionary activity that requires each pattern to be continuously reviewed and refined. The documentation of the architecture thus becomes a "living document."

The project team identified and outlined a set of information processing tasks they believed to be common across all business applications. A small sample of these tasks are further documented and illustrated as examples of the patterns that form the basis of the envisioned architecture. The first, a ***finder pattern***, is used to identify an object in the database that the user wishes to view. A finder prompts the user for information that could uniquely identify the desired object. If such information is not available, the finder should prompt the user for more general attributes that can be used to search for a collection of objects that meet the specified criteria. In this latter case, execution of the finder would generate a browser. A ***browser pattern*** provides a list of objects, with enough information to allow the user to specify the exact object to be viewed. The next pattern, a ***viewer***, displays the object. The viewer is typically segmented into pages or scrolling sections to allow all attributes associated with the object to be viewed without invoking additional transactions. Viewers also provide "hot button" links to other associated viewers, making it easy to locate related information. Finally, a ***view-before-update*** pattern specifies that you must view the attributes associated with an object before entering a mode that allows you to modify them.

One of the premises of the architecture is that these patterns, among many others, would repeat over and over again in different applications, with only the specific data elements changing from application to application. For example, a student finder would prompt for an ID number, but also allow a search on name; a purchase order finder would prompt for PO number, but allow a search by account number, user, vendor, and commodity; and a course section finder would prompt for term and course reference number, but allow a search by subject, number, and campus. If all of the University's business applications were constructed from such recurring patterns, it would be easy for users to master the interface and seamlessly move from one application to another.

## Architecture Prototyping

The information architecture project staff preferred to recommend guidelines that could be implemented using state-of-the-practice technology and reasonably cost efficient methods. For this reason, several of the principles espoused in the architecture statement were illustrated through a set of prototype applications that would serve as "proof of concept." Some of these principles are:

- The client/server model should serve as the basic paradigm for applications in the University Information System;
- All business applications should share a common graphical user interface (GUI), initially based on the Windows GUI, but ultimately embracing multiple platforms (Macintosh, X-Windows);
- The common GUI should provide a consistent look and feel across all applications;
- The common GUI should be easy to learn and use; it should be intuitive and consistent with the standards relative to its particular platform; For example, if an application is running on a Macintosh machine, it should behave as a Mac application, not a Windows one.
- The common GUI should enable easy transferability of skill from one application to the next, and facilitate substitutability of personnel across applications; and
- Applications should easily integrate with desktop personal productivity tools.

The architecture staff completed four major prototypes during the first year of the project.

### Course Inventory Prototype

The first prototype, the ***Course Inventory Prototype***, was a Microsoft Windows application created using Visual Basic. The prototype was designed to provide query access to course inventory data that had been extracted from ISIS and converted into an SQL database (Microsoft Access). Because of the relatively static nature of course inventory data, this approach offered an acceptable means of enabling access to the ISIS legacy data. The Course Inventory Prototype illustrated several of the information processing tasks (patterns) that had been articulated in the architecture statement, including the finder/browser/viewer paradigm.

To maximize the reusability of application program code, the first prototype was designed to be as data independent as feasible. For example, instead of hardcoding the association between a database field and its display field in a window, the application used metadata, stored in a relational table, to link all display fields to the database. This allowed developers to quickly create a new window by first creating a new table in the meta-database delineating the required data elements and then cloning a similar existing window.

### Application Builder Prototype

The finder/browser/viewer paradigm developed in the first prototype was replicated in a series of six smaller prototypes developed by Information Science graduate students. These student prototypes involved a wide variety of topics, including a classroom scheduling package, a car dealership program, a real estate program, and a purchasing system. This set of prototypes help verify the Team's assertion that the patterns being developed were flexible and generalizable.

Based on the experience of advising the graduate students in using the patterns to create additional prototypes consistent with the architecture, the Team developed a second major prototype, the ***Application Builder Prototype***. This prototype carried the data independence discussed above even further. Twelve of the fifteen code modules created for the first prototype were generalized so they could be completely driven by metadata. The remaining three modules could then be tailored to create a unique application with a finder, browser, and viewer. This allows a programmer to generate a new application simply by creating the metadata and laying out fields on the viewer window. The Application Builder Prototype thus illustrates the possibility of creating an application software library containing reusable software components that embodied the identified patterns.

### Class Roster Prototype

Because ISIS is the newest and best of the legacy systems, it is difficult to imagine a set of circumstances that would result in it being given a high priority for replacement. Therefore, it would be highly desirable if it could be cost-effectively modified to better fit the architecture. This means, among other things, that ISIS should have a graphical user interface (GUI) instead of the existing character-based interface. In response to this dilemma, the Information Architecture staff began work on a client/server prototype application to access ISIS data via a GUI front-end.

None of the earlier prototypes were examples of true client/server applications, nor did they wrestle with the problem of accessing the data associated with legacy applications. A new prototype was needed to address these two important issues. The Information Architecture staff polled faculty in the Senate Computer Usage Committee for suggested applications that would be potentially useful to a large number of faculty. Instructors had long expressed the desire to gain easy electronic access to up-to-date class roster information. A class roster is a list of students who are registered for a particular course section. This seemed a simple, but important, topic, so a third prototype application, the ***Class Roster Prototype,*** was initiated with the goals of: (1) illustrating principles of the information architecture, (2) demonstrating the feasibility of client/server technology, and (3) testing the feasibility of accessing ISIS data through existing CICS transactions.

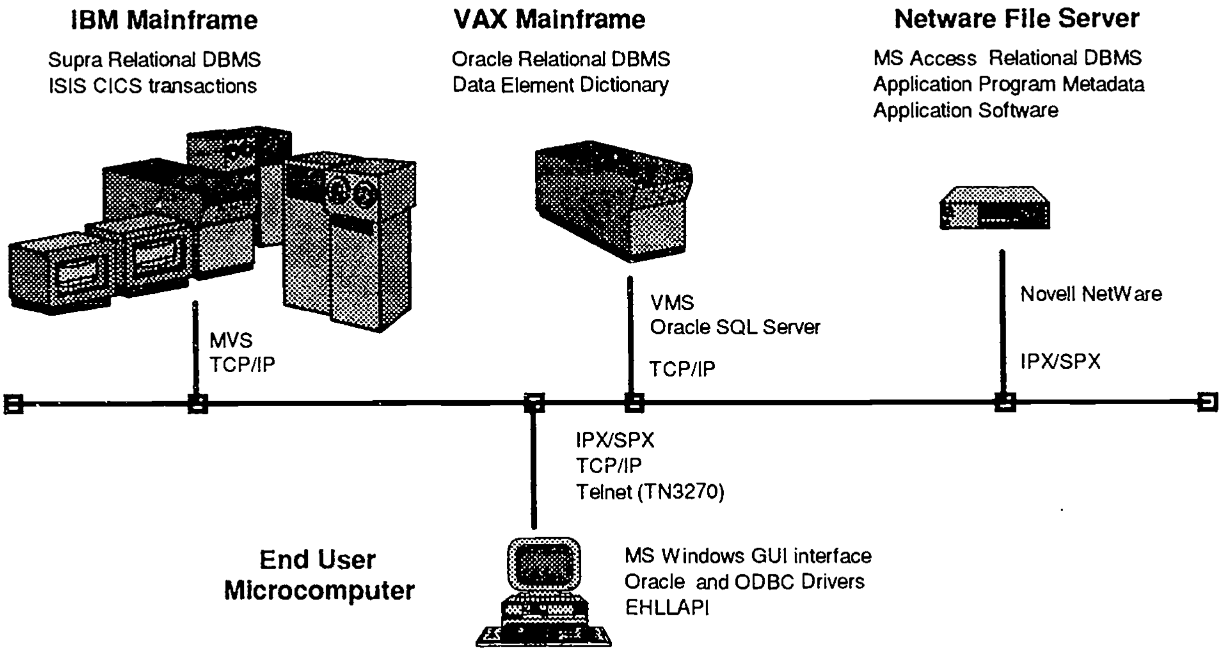
The project development team first sought to access the ISIS data in its SUPRA database. Because no middleware could be found to directly access ISIS data in client/server mode, the project developers decided to employ "screen scraper" technology to access the course and student data through the existing front end CICS transactions. This approach involves building a windows-based client application that establishes a terminal emulation session in the background. The terminal session is then accessed by the windows application via EHLLAPI (Emulated High Level Language Application Program Interface) middleware. The EHLLAPI middleware allows strings of information to be sent to the host terminal session and retrieved ("scraped") from the resultant screens. To the host machine, the terminal session appears to be just another interactive user. At the client workstation, the user may not even be aware that data is being retrieved from a terminal session rather than a database.

Using this approach, the project staff designed an application that would allow a faculty member to interact with a GUI application to access ISIS. The application attaches to the host in background mode, and accesses the existing ISIS CICS transactions to generate a class roster. The class roster window displays general information about the selected course section and displays a scrollable grid containing data about each student enrolled in the course section.

To launch the Class Roster Prototype, the user first logs into an application server, which downloads the required executable images, libraries, and VBX's (Visual Basic Extensions) to the client workstation. The application accesses a meta-database (Microsoft Access) on the server.

This database contains information about the location, length, and type of student and course data on the ISIS screens that would be scraped.

### Architecture of Class Roster Prototype




In the background, the application logs into an Oracle database server, which provides a repository for the University's data element dictionary. The application connects to Oracle SQL Server, and accesses tables containing valid values for ISIS data elements. This component of the system represents "true" client/server technology, where the client application transmits an SQL statement to the server, the server's SQL engine processes the statement, and only the results of the query are sent back to the client.

The actual student and course data reside on the University's administrative data processing machine, an IBM 3090. Behind the scenes and transparent to the user, a telnet terminal session logs into the host production database, using a user-supplied name and password, and subject to standard mainframe ACF2 transaction security. The telnet session then sends transaction strings to the host, which processes the transactions and returns screens of information to the client application. Access to this host data is accomplished through a Visual Basic code module that interfaces with EHLLAPI middleware. The middleware is implemented in the McGill University dynamic link library (DLL) and is accessed via function calls defined in a McGill-supplied Visual Basic code module.

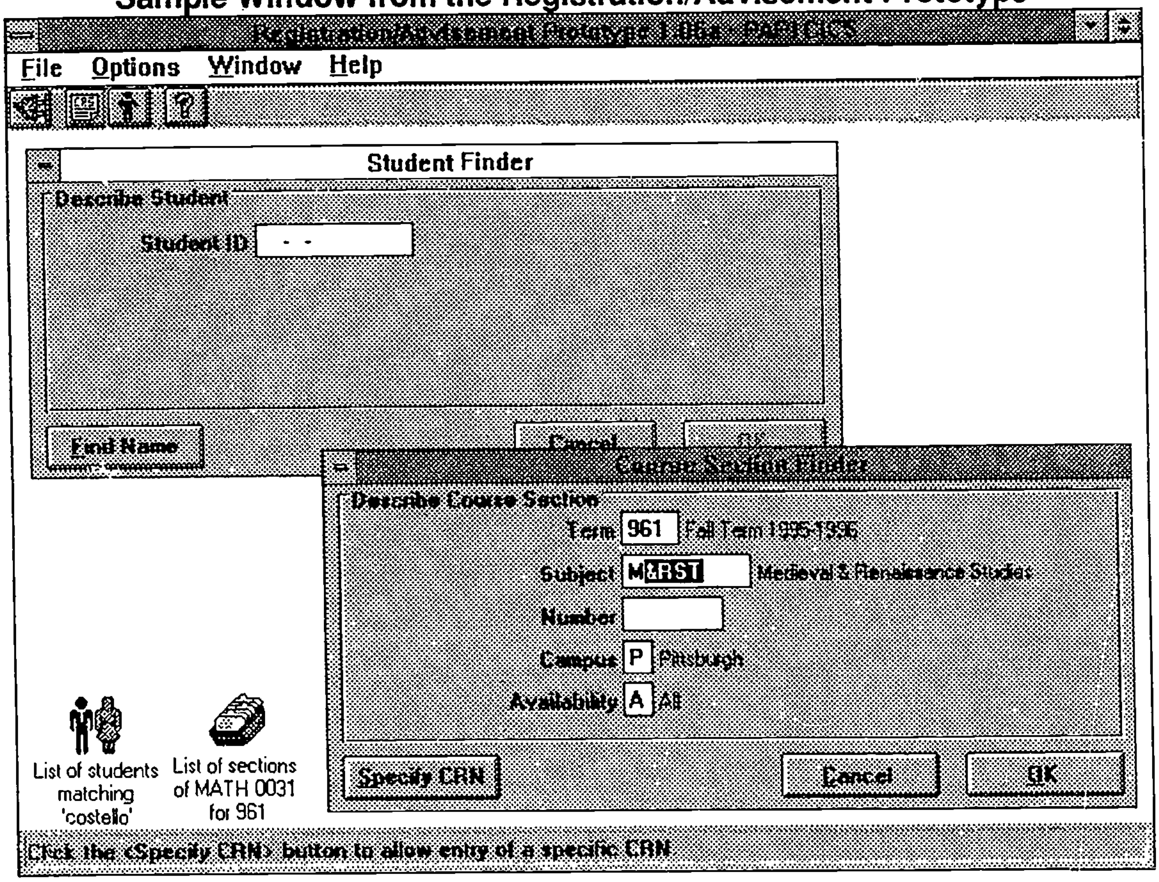
The Class Roster Prototype was a proof-of-concept prototype. It demonstrated a true client/server application that simultaneously accessed a file server, database server, and mainframe. It also illustrated the ability to access legacy system data through the front end CICS transactions.

### Registration/Advisement Prototype

The success of the Class Roster Prototype prompted the Director of Student Registration and Financial Services to request that the Information Architecture Team initiate a larger project to develop an application that could be deployed in production mode across the University. The ***Registration/Advisement Prototype*** was intended to create an interface to ISIS that was consistent with the envisioned information architecture, and that would allow faculty advisors to access course and student information and to actually register their advisees into course sections in real time. As did the other prototypes, the Registration/Advisement Prototype was designed to illustrate the principles articulated in the architecture statement. However, instead of proof of concept, it would need to be a working application that would read from and write to the production student database.

The Registration/Advisement Prototype Project was initiated in May of 1994, as a joint venture between the School of Library and Information Science, who volunteered to test the new application, Student Registration and Financial Services, and Computing and Information Services. The Registration/Advisement Prototype used the same technology as the earlier Class Roster Prototype.

**Sample Window from the Registration/Advisement Prototype**




The sample window from the Registration/Advisement Prototype illustrates two instances of a finder pattern. At the top of the window is a student finder, prompting the user for a student ID. At the bottom, is a course section finder, which is in the mode of prompting for attributes to generate a browser. This mode is relevant when the user does not have the precise information needed to uniquely identify the desired object, in this case a term designator and a unique course reference number. In addition to the two finders, the prototype uses the following windows:

- Browsers: Course Inventory, Course Section, Open Course Section, Student, Advising Records

- Viewers: Course Section, Class Roster, Student (demographic, registration history, service restrictions), Advising Record, Registration, Academic History
- Update Windows: Student (demographic, registration history, service restrictions), Advising Record, Registration
- Utility Programs: Login/Logout, Change-Password, Download (download to file, send to printer, or copy to clipboard)

This set of windows, through their associated ISIS transactions, can provide access to all of the information that is relevant to an advising and registration session. The advisor can check the student's address information, ensure that the student is enrolled in the appropriate academic program, and ensure that there are no service restrictions (holds) associated with the student's record. This data can be corrected and updated as needed. In addition, the advisor can examine the student's class schedule for any term, as well as the academic record (transcript data) sorted by term or by subject. The advising component allows the advisor to view and create electronic notes and associate them with the student's records. These are stored in a local Microsoft Access database (at a school- or department-level). The advisor can access up-to-the-minute information about course sections, and, if a desired section is closed, even search for alternative sections that do not conflict with the student's schedule. Finally, the advisor can register the student, and give the student a printed confirmation of registration.

The program developers employed an iterative development methodology based on principles associated with rapid application development. This methodology involved the successive repetition of the analysis, design, prototyping, testing, and review steps in close conjunction with the targeted end users. The application underwent seven upgrades using this methodology during its first year of operation. During that time, it was deployed to faculty and staff in the School of Library and Information Science, the School of Education, the School of Pharmacy, the School of Nursing, to the Director of the College of Arts and Sciences Advising Center, and to staff in the Student Registration and Financial Services area, for a total of 90 users. It is also being deployed at the Bradford, Greensburg, and Titusville regional campuses.

By all measures, the Registration/Advisement Prototype has been a resounding success. With the significantly improved access to course and student information, faculty feel much more efficient and effective in fulfilling their advising role. Students have been vocal in praising the responsiveness of the new process. They can do "one stop shopping" in their advisor's office, avoiding a trip to the central Office of the Registrar, and the inevitable wait in line. More importantly, they never have to return to their advisor's office because the course they were advised to take is closed.

## The Registration Project

The Information Architecture and Process Innovation team recommended that the architecture be implemented through a project approach. Projects are proposed by design teams that are formed within the administrative and educational units of the University. These teams may be reengineering teams, or they may be smaller incremental improvement teams. The teams propose projects in accordance with detailed guidelines that ensure they will be aligned with the information architecture.

Based on the success of the Class Roster and Registration/Advisement Prototypes, and on the University's long-standing interest in implementing a telephone registration system, the ***Registration Project*** was initiated to investigate ways to improve the registration process.

This Registration Project followed the University's business process reengineering methodology, except for one fundamental point - it did not start from scratch, but rather assumed that the legacy student system (ISIS) would not be significantly changed. Lynch and Werner[4] observed that the most profound element of reengineering methodology is reconceptualizing the fundamental nature of work. The Registration Design Team attempted to meet this goal by including a mix of personnel from several academic, administrative, and technical units. This was intended to foster the notion that such partnerships will produce a better design in a more cost effective manner than if any one of the team components attempted to implement the project alone. The design team concept took advantage of the expertise available across the University and permitted multiple views of the information system project.

The Design Team's recommendations call for further deployment of the Registration/Advisement Prototype, as well as the creation of new capabilities for the related processes of course scheduling and academic advisement. Implementation will be phased in over a three year period, culminating in student self-registration via client/server technology and telephone.

This Registration Project is one of six projects that were proposed as implementations of the UIS architecture. To date, four of the projects have been accepted for implementation: (1) the registration project, (2) implementation of the procurement process (reengineered during the Information Architecture project), (3) reengineering of the human resources process, and (4) acquisition of key components of the infrastructure, such as the site license for the Oracle DBMS and development tools.

## Summary

The Registration/Advisement Prototype had its roots as a proof-of-concept application to demonstrate the feasibility of client/server technology and the principles articulated in the University Information System architecture statement. It has evolved into a powerful application that promises to fill an important information need for faculty, staff and students.

Experience during its first year of development and implementation shows that legacy systems can be enhanced with relatively little effort to have the same look and feel as more user-friendly client/server GUI applications. Such enhancements enable legacy data to be available to the occasional user, and not just to the trained specialist. Additional efforts are currently underway to address the other serious problem with legacy systems, the ability to easily access legacy data on the back-end. Consequently, developers believe that legacy systems can be modified to become a viable component of the envisioned University Information System, at least until priorities allow them to be more completely addressed.

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[1] Nicholas C. Laudato and Dennis J. DeSantis, "Reshaping the Enterprise: Building the Next Generation of Information Systems Through Information Architecture and Process Reengineering" *CAUSE/EFFECT*, Winter 1995

[2] Christopher Alexander, *The Oregon Experiment* (New York: Oxford University Press, 1975)

[3] Christopher Alexander, *A Pattern Language* (New York: Oxford University Press, 1977)

[4] Robert F. Lynch and Thomas J. Werner, *Reengineering Business Processes and People Systems.* (QualTeam,Inc., Littleton, CO. 1994)

# Strategic Planning for A Library, Computing and Media Support Organization

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Under severe constraints of a public budget in a poor state, the University of South Carolina has examined every phase of services and operations. Central computing, libraries, distance education and media production had been combined for a year when their formal planning process began -- the method, classic strategic planning with broad staff participation. The goal of the process is an ongoing, vital planning process. The panel will look at the method used in planning and the process as well as local roles and issues. The panel will touch on issues of differing professional cultures and of the tensions of change.

The merger of University Libraries, Computer Services and Distance Education and Instructional Support led to the need for division wide strategic planning. Of a total University faculty and staff numbering around four thousand, the resulting Division of Libraries and Information Systems has a staff of over four hundred.

Why plan?

A primary goal of the planning process has been to engage the organization in change in an ongoing way, the better to enable it to operate in a dynamic fashion. Because of its several information "businesses", the University Provost has laid on the Division the burden of leading the University into the next phase of its evolution. Involving all our Division's staff in continual renewal makes it more likely the Division will carry the weight. To emphasize the ongoing nature of planning, "planning process" has been preferred to "plan" as the term for the activities of the last year.

Because of the youth of the Division -- created in October, 1993 --another chief goal of the planning process was and is to create a coherence for the Division. This sense of the whole has been emphasized in every aspect of the process, beginning with an emphasis on broad staff participation.

Let us look at events and then roles in USC's planning process. Then, let's look at cultural factors, critical local issues and current developments.

The Process

A - Establishing the process

The first stage of the planning process lasted for ten months, from October, 1994, to August, 1995, culminating in a report to the chief of the Division, the Vice Provost and Dean. The report claims to be "a formative step in uniting the Division", the result of its "first comprehensive self examination". To reach this milestone, the Division began by choosing a strategic planning consultant to assist in establishing the process. The strategy within the plan was to employ the classic strategic planning approach but to invite broad staff participation. The consultant had us first convene three dozen division faculty and staff from all levels to set the direction for the planning process.

After this retreat, a steering committee was organized, composed of two members each from the three major areas (Computer Services, DEIS and University Libraries), one Division director and two members from beyond the Division (an Associate Provost and the Registrar Emeritus). A Division staff member provided executive assistance.

Over the succeeding nine months, the steering committee devised and executed a process that was divided into three phases: setting a planning framework (Phase I); acquiring information and deriving recommendations (Phase II); clarifying and presenting overall recommendations (Phase III).

B - Discussion (Focus) Groups

In Phase I (November to February), internal assessment began. Controlled discussion groups were held to get perceptions from division employees on key trends, the strengths and weaknesses of their departments and the Division as a whole, the effects of the merger, etc. in a loose agenda of "what works" and "what doesn't work". The interviews were confidential; after careful cross-checking and analysis, summaries were prepared and given to the Dean in

July (Phase III) to provide snapshots of the conditions at the time of the discussion groups.

C - Work of the Units in the Division

To complement the observations of the people of the division, the steering committee asked the eleven who work immediately below the Dean (that is, the Directors) to detail the work of the division's many units. Producing these descriptions took a painstaking effort that extended to the end of Phase II. These documents were termed "Work Processes": specific activities under these rubrics were reported as "Work Projects". These documents all the participants in planning and were included as an appendix in the final report.

D - Communications: Plans and Execution

With the help of the consultant, the steering committee initiated a communications plan. From the time of the original retreat, written and verbal channels were used: an open listserv; a bulletin board to hold significant documents, such as the report of the retreat; open meetings at important junctures to summarize activity and take comment; widely available written and electronic copies of visuals from planning sessions; and communications in regular stafff meetings. From February on (end of Phase I), news of the planning process was sent to all members of the division approximately every six weeks. Tours were offered in December and January to encourage people to familiarize themselves with facilities occupied by other units. General communication was probably increased when faculty and staff interacted on task forces and then returned to their departments.

E - Task Forces

A critical element of the planning process took place in task forces that worked from February to early May (Phase II). The topics of their study flowed from seven overarching categories identified in the October planning retreat: Marketing, Service, Technology, Staffing, Financial Management, Division Infrastructure, and Organizational Coherence. Under these broad headings, more narrowly focused task forces were created.

The focus for each was defined by the steering committee. Once the task forces were formed, charged and trained by the consultant, each launched into the research and analysis of its topic area. Each task force had a designated liaison to the steering committee. The consultant encouraged every group to develop its own way of working: conduct of the task forces varied widely, from chair-less groups to single-leader groups. Each examined and modified the charge as indicated by their expertise and resubmitted the charge to the steering committee for approval. At the end of March (mid Phase II), the task forces presented progress reports. Then they moved to finalize their findings (near the end of Phase II).

The final reports of the task forces, consisting of background, recommendations and sources consulted, were published electronically and printed for circulation to all departments. Comment was invited in open meetings and privately via a comment form.

F - Recommendations and a Published Report

An important activity began in Phase III (June and July): several meetings took place with directors and steering committee for the purpose of interpreting and responding to the recommendations of the eight task forces. The directors separately rated the recommendations (as did Steering Committee members) and then collectively examined them. With the directors' responses in hand, the steering committee sought to establish the most favorable recommendations and bring out points for clarification.

Directors took the opportunity at this point to identify additional topics of promise for the Division at large. A healthy tension was felt between initiating change in the normal course of operations and incorporating these changes in a longer-term framework. The remainder of Phase III (end of July to mid August) was taken up in completing the elements of the report, with special attention to the roughly fifty recommendations and to suggested plans for implementation.

### G - Implementing and Continued Planning

When exactly did we begin implementing? Implementation took several shapes.

Because some initiatives were deemed likely to increase Division coherence and efficiency and because they fell outside the scope of any task force, these were undertaken before the report was finished. Collapsing the several courier and delivery services for books, computer printouts, computer and audio/visual hardware and wiring, etc., fell into this category. Another important decision (confirmed independently in Focus Group reports) was taken by management during Phase III: directors and other managers needed leadership and other managerial training to reduce frustration in the Division and increase the quality of outcomes from all Division effort.

After the publication of the report, five of its recommendations were chosen for immediate action. Teams drawn from across the Division were charged with implementing three of these; a suitable plan of attack has not been confirmed for the other two.

A Monitoring Group was convened in late October (i.e., a full year after the start of the process and a two years after the creation of the Division). The Monitoring Group has devised a method of tracking and reporting progress on recommendations and of alerting management when an implementation goes wrong or too slowly. The same day the Monitoring Group began operation, the Steering Committee was discharged.

Did we stop planning? No, but we are not going back to our old way of planning. The report as submitted alluded to "Area Planning" (where "Area" is the terminology used for one of the large parts of the Division such as the Libraries). As amended by the Dean, the continuing planning at lower levels of the Division is being accomplished by a look at services, clients, future trends and proposed new approaches to providing the needed services: this is termed "models of service". By the mechanism of "models of service", each unit is to revise or reinvent itself to provide better service to its clientele while being looking for ways to integrating more closely with other Division units. In this effort, the units are encouraged to stop offering certain extraneous or unaffordable services. The deadline to make this new conception of their departments is March, 1996, six months after the challenge was derived from the report.

### Roles & responsibilities

Here then is description of the roles played so far in USC's planning process by the various actors. The consultant facilitates, engages, encourages and suggests models. She trains groups, sets timetables and milestone and launches them into their tasks. She diagnoses and troubleshoot sub-processes in the process.

By design, the remainder of the characters come from the institution. The sponsor (the Dean) acts, choosing to embark on the process, finance it and to champion it. He has pointed out key individuals to invite into the process. He injects direction into the process and pushes for implementation.

We have introduced the two original contractors for the planning service. Next come a number of planning groups. The original planning group (three dozen division faculty and staff) set the direction for the planning process. The nine person steering committee was to manage process, communicate to staff and management, commission and manage task forces and ad hoc groups, and submit a report to the Dean. Both these groups needed courage and confidence.

The Task Forces of Phase II of the process were described above. These investigated their topic areas and reported recommendations. Several of the reports went far beyond the charge, making observations and recommendations which could still be used. Members of these groups balanced the intense two-month commitment with the continued connection to their ordinary duties.

Another type of ad hoc group is exemplified by the discussion groups begun in Phase I. These were organized by a steering committee member with professional training in this area and consisted of a cross-section of people in the areas of the Division. Their role was to comment on conditions in the Division; in so doing, they made useful comments on management, the requirements of their job, virtues of the Division and how things might be improved.

During the course of planning, Directors often convened ad hoc groups from their units to answer questions posed by the Steering Committee and by various Task Forces. This continued past the August report date, to begin the six-month thrust to create new service models. The form and duration will differ with every recommendation, but ad hoc Teams will often be the mode of choice to implement a recommendation.

An "internal consultant" evolved within the Division. One of the directors had begun training himself in facilitation for a different purpose and took advantage -- much to the benefit of the planners -- of the consultant's availability to advance those skills. He helped the Steering Committee and the Directors in Phase III to negotiate through the adoption of recommendations. He also conducted some training for the Steering Committee to make them more effective as a group.

On the several levels below the sponsor come the directors and managers. With managers, the directors cleared people for planning assignments and reassigned work in the interim. The directors reviewed planning recommendations and proposed other complementary ones; after adopting a recommendation, they have confirmed the Strategic Plan's action plan, substituted a design or commissioned a group to carry out the recommendation. Throughout, directors have had to interpret the course of events in planning and then to translate for their faculty and staff, while soliciting their questions and input. They also sought to balance the disruption caused by the planning activity to normal operations and traditional assumptions. This was a role requiring judgment and trust.

What of the rest of the Division? About one hundred of the Division's four hundred members have participated in planning. If one has still not served in a planning or implementing activity, more than forty recommendations will need implementors. In another sense, the whole Division can participate by studying the report and responding.

And the Division's clients? Through the twists and turns in Phases I and II, it became obvious that the Division would first be involved in an examination of internal systems and was not ready for a comprehensive review of services with all the client groups. This activity has awaited the "models of service". With the exception of some Task Force inquiries and a single departmental survey, there was little to go on before the August report. Immediately after, some general topics of campus infrastrucure for academic computing were reviewed. Immediately afterwards, a "Computing Issues Report" was commissioned, to get some clients of academic computing to bring forward some of their general goals and parameters. This should be a good beginning for several of the units as they develop their models of service.

### Cultural issues and challenges

In the 'marriage' of the older organizations, both clashes and matches resulted. Several levels of culture clash came into play in the combined information organization: inter-departmental, inter-specialty, intra-organizational. The inter-departmental culture conflict was sometimes based on personality types. For example, when a group of largely introverted, highly organized individuals attempted to wrestle over issues side by side with a group of looser, more extraverted individuals, confusion could ensue or disagreements arise.

Inter-specialty conflicts have more to do with the differences in labor performed rather than with personality; however, differences of this kind have just begun to appear and their effect is difficult to judge. The types of differences have to do with the contrasts among operational, clerical, creative, analytical and other occupational sub-types that work in the Division. It is clear that some in the libraries, say circulation staff, for example, have more in common with operations staff in computer services than either has with collection development or University arcives personnel in the library or instructional developers in distance education. Most helpfully, once the similarities are discovered, a model from one area can be borrowed and applied. Where differences are honored, then different approaches can also be respected.

Intra-organizational conflicts or barriers were found between areas, between units within areas, between management and staff. Discussion groups revealed the extent and pointed toward the causes of some of these. However, relationships predating the planning and even the formation of the Division formed an amicable basis for cooperation in the planning process. For example, it took only five minutes of discussion in the initial planning meeting to point to four successful projects from the previous decade brought about by the combined effort of staff from the three major areas.

### Critical Issues

Through the description of events and players above, some critical local issues can be seen. Because of the size of the Division and physical separation of its facilities, communications were especially important. To attempt to have broad staff participation meant using many media and many venues. The Division found its own weak spots -- lack of up to date office addresses, incomplete lists of unit members, outdated titles, no preexisting communications vehicles to address the whole Division, no room big enough for larger planning events, no standard e-mail package in use, no standard word processing package -- addressing these weak spots in itself is creating a more coherent and rational organization.

Planning and operations have come into conflict. If you are not careful, questioning all the premises of gravity and tensile strength while a climber is clinging to the cliff from a rope will alienate you from the climber. Likewise, there is a natural tension at work between the planning and operational mentalities. Management varies in its temperament with regard to profound planning activity. Nevertheless, the involvement of our directors in Phase III of the process produced a far more implementable plan. While some recommendations may not have been included due to management's objections, most were. Having seen them, management also has considered at least superficially how the outcomes of the recommendations might look.

### Current Developments

In the original planning retreat, planners took imaginary snapshots of what the Division would be doing in the year 2000. Likewise, they named the values they used or wished to use consistently in their daily work. The first exercise led to the development of vision statements published in the August, 1995 report. As early as the fifth month (end of Phase II, beginning of Phase III), it could be seen that the Division would choose to focus on internal systems, to focus on efficiencies instead of exploring further the territory of values, vision and objectives. (So, for example, the first recommendations undertaken are all five drawn from the categories of Division Infrastructure, Financial Management and Organizational Coherence.)

In the Division's leadershop training, some Division values can be clarified. Useful goals for rank and file to complement the vision statements are most likely to come out the effort to create new service models -- the deadline: March, 1996. It will be interesting to see what happens as a result of our strategic planning process.

# Restructuring the Information Technology Organization To Improve User Services and Return on Investment: Do Compromises Work?

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Abstract

In the last several years, Central Michigan University reached a level of technological growth, excitement, and frustration that significant changes in both the information technology infrastructure and organization were necessary. The university employed a combination of external consultants, an internal technology task force, and electronic "town meetings" to discuss and recommend a new organizational approach to implement and support a technology initiative. The resulting initiative will include an expanded campus network, computing system upgrades, new uses of distance learning technologies, and increased coordination of user support services. A new matrix organizational structure for information technology governance was developed that acknowledged the value of both distributed support and a strong central organization.

Many papers and conference presentations have studied the changing information technology organization. A wealth of information on this topic is available at the CAUSE web site (http://cause-www.colorado.edu/). Factors that differentiate institutions and can influence their information technology capabilities and organizations include size, status, funding level, and mission. Central Michigan University (CMU) is a public comprehensive institution with approximately 16,000 students, located in a rural area in the center of Michigan. It is one of fifteen public universities in Michigan, one of a hundred and five higher education institutions in the state. CMU has a large teacher education program and one of the largest colleges of extended learning in the country. The university also runs a tight economic ship. Among our competitor universities in Michigan, CMU is second to last in student tuition and ranks in the bottom third for state funding on a per student basis.

## Historical Antecedents to Organizational Change

**Mainframes and microcomputers**. CMU, like most large institutions, has a mainframe and many personal computers. It would be difficult to discuss the impetus for organizational changes in information technology without mentioning this obvious fact. Most people have a good sense of the power of PCs, even if they are not proficient with their operating systems, applications, or operational features and practices. Many correctly perceive a sharp contrast between the usability of the PC and the capability of a mainframe that they understand even less about than their PC. Almost as many have definite ideas and opinions about PCs and mainframes, what they can and cannot do with them. It has become the *zeichist* to call all mainframes legacy systems to contrast them with PCs and client/server computing The term legacy evolved as PCs became more powerful and were connected to each other in local area networks. CMU has an excess of legacy technology beyond its mainframe that includes some of its personal computers, software, telecommunications equipment, and networking.

This term client/server simply means that data processing is a shared workload of interconnected computers. For large enterprises, client/server computing has become a strategic concern for business productivity and adaptability to change. The most important aspect of this function is empowerment of the user's desktop computing environment and corresponding opportunities for instructional and business processing reengineering. The limit and costs of client/server evolution are indeterminate since personal computers, servers, and networks are still evolving. Technical details, such as standards, interoperability, and security go beyond client/server functional goals but have potentially significant impact and risk. This topic is central to a discussion of improving user services and maximizing return on investment, but now is merely introduced as historical background on the impetus for changing the information technology organization.

**Development of the campus network**. Significant progress was made in the last three years to create a fiber optic 100Mb/sec FDDI campus backbone network that currently connects thirteen buildings although only a few of these buildings are completely internally wired. The campus network, which now includes about 1,000 nodes, uses primarily Category 5 cable from nodal equipment back to wiring closets. Within-building backbones are multimode fiber. While the current FDDI network was well planned, funding has occurred in piecemeal fashion from faculty grants, departmental or college computer upgrade projects, and state-funded building projects. As use of the network developed, further expansion, management, maintenance, and longer-range planning became a priority.

The current network plan is being revised to upgrade the backbone to a more robust Asynchronous Transfer Mode (ATM) protocol that will provide the capability for both video and data and, eventually voice. In this revised plan, all campus buildings not currently on the network will be added to an ATM backbone. Because of cost, the FDDI backbone will not be upgraded initially but the ultimate goal is to upgrade the entire backbone to ATM. The planned network expansion will include enhanced dialup facilities for off-campus access and network authentication, and software servers to support a distributed computing environment. While the data network was being established, the university's

Telecommunications department was developing the use of interactive television for distance education. Public Broadcasting was also starting to plan new possibilities for educational programming with the anticipated availability of digital television technology. A long-range technology plan will need to evaluate all these potentially important delivery systems.

**Decentralized technology**. The university currently spends approximately 35-40% of its technology dollars on personal computing and associated support. As end-user computing became more important over the last ten years, decentralized technologies and support became an increasing proportion of total expenditures. Today the issues for decentralized computing are a combination of basic needs such as training, maintenance, support, and upgrades, and production opportunities, such as instructional application development and distance learning, which require an infrastructure of networking and support to be in place.

**Technology outside the walls of the university**. The development of the Internet and telecommunications technologies have already had some impact on the university's historical involvement in distance education. Until now, the program has been effectively distributed via traditional teaching methods to off-campus students at regional centers located primarily in Michigan and also at other national and international locations. Given the rapid growth of distance learning technology, upgrading this long-lived and successful program is recognized as a critical part of our vision of a twenty-first century university. CMU has started to use interactive television and the Internet to improve educational content and further reduce the constraints of geography on distance learners.

**Campus technology organizations and technology culture**. For CMU and most institutions, rapid technology-driven change and the realities of finite resources have challenged many elements of their institutional infrastructures.[1] We now need to change the organization to adapt to this growth. The trouble is that organizations are often much more slow to change than technology. An appropriate funding model is a very critical part of the challenge. When funds are plentiful, it is much easier to achieve cross-organizational collaboration, and priorities are relatively easy to negotiate on an informal level. Very few institutions, especially public institutions, are beyond the point where funding and costs are not under tremendous scrutiny. Information technology has high visibility, high cost, and merging functions of voice, video and data. There is also a history of decentralized user constituencies that want control over resource decisions, including technology, that effect them greatly. There would be no impetus to change the campus technology organization if most users were satisfied with the *status quo*.

## Approaches to Organizational Planning

When Leonard Plachta became president of Central Michigan University in 1992, he brought with him a view that universities must learn to operate more as a business. He has repeated this theme often, stressing the ideas of the student as a customer, and his gospel of efficiency and effectiveness. In one of his first presidential addresses Dr. Plachta stated his belief that technology was essential to achieve many goals for the university.

> <u>The student is a customer</u>. This statement has been the subject of a continuing debate in higher education. On one side is the view that the faculty-student relationship is unique, i.e., the faculty mentor is a source of knowledge and wisdom--the most likely to be "right." In business however, the customer is often told that they are right. However, both views agree that the student is important--the *raison d'etre*. The business analogy merely serves to stress that education is a business that must offer a quality product at a competitive price.
>
> <u>Faculty must embrace the use of technology to improve teaching effectiveness and efficiency</u>. In the past decade, public education has been and will continue to be under very heavy public scrutiny. It is increasingly possible for educational service providers to offer their services/products to a global

student/customer market via distance learning technologies. Those universities/companies that can offer the best products at the best prices will be successful and those who cannot make the adjustment will falter. This has always been the case in business and education is no different. To become more efficient and effective, faculty and staff must (a) have access to technology that is current, works well, and is easy to use; (b) receive appropriate training and support; and (c) be willing to change.

**Influence of technology on the university mission statement.** In 1994 our academic mission statement was revised to include goals related to the use of technology. This increased technology emphasis reflected a broad-based understanding of how technology can improve academic outcomes. It is widely believed that technology is escalating the limits of information access and capacity, and creating new opportunities for communication and collaboration. The revised mission statement speaks directly about the role of technology and underscores the faculty commitment to reengineering instructional processes and expanding their vision of the campus and student market.

- "CMU will become a leader in classroom learning technologies to enhance the delivery of education to students both on-and-off campus."
- "In order better to serve its students and the wider community, CMU will:"
- "Employ the latest electronic technologies for the processing and dissemination of information; provide access and training in the use of such technologies to all students, faculty, and staff; and develop new modes of instruction and educational outreach using such technologies."
- "Develop and employ alternative delivery systems to meet contemporary educational needs for a wide range of students whose family or career obligations limit their access to a campus."

**Assessment and recommendations of outside consultants.** A shadowy future of converging multimedia telecommunications and computing requires difficult decisions about technology, people, budgets, and organizations. Which technologies are necessary? How will technology affect both technical and nontechnical jobs? What is the appropriate balance between cost and benefit? What types of organizational changes are needed to maximize return on investment and provide a competitive advantage?

In 1994, the university sought the advice of a technology consulting firm to assess the current environment and make recommendations about technology change and organizational strategies for how to accomplish the change. The consultant recommended an aggressive transition into a client/server application environment and suggested either (a) reorganizing and refocusing internal technology support or (b) outsourcing. Either of these recommendations suggested considerable change and would impact significantly on the personnel and systems that were in place.

**Assessment and recommendations of an internal task force.** In January 1995, President Plachta appointed a Task Force on Technology that comprised representatives from many campus constituencies. The Task Force worked on an extremely ambitious timetable, committing a large part of their weekends for several months to discuss and plan technology from an internal perspective. The group did not use the consultant report to guide their work but wanted to be free to explore various objectives and approaches to technology organization. An e-mail list was employed to solicit ideas and opinions from the entire campus. The following set of goals and key activities were developed:

<u>Goals</u>

- Encourage students, faculty, and staff to learn and use basic technologies needed in contemporary society, as well as specialized technologies appropriate to their disciplines and roles.

- Provide and encourage the use of technology to improve teaching and learning, research, and service.
- Use technology to facilitate and improve communication and instructional delivery between and among on- and off-campus constituencies.
- Establish a process for ongoing planning and evaluation of technology initiatives.
- Establish funding mechanisms to acquire, support, maintain, and upgrade basic and specialized technology resources.
- Promote the development of user-friendly applications of technology.

Key Activities

- Establish a technology planning and organization structure.
- Upgrade student computer labs.
- Acquire faculty and staff computers.
- Establish a technology training center.
- Integrate instructional development and multimedia functions into the training center.
- Implement a student technology fee.
- Complete the campus network.
- Improve remote computing capability (Internet access, modem pool, off-campus lines).
- Upgrade the mainframe.
- Upgrade residence hall technology.
- Expand and upgrade library facility.
- Mediate additional classrooms.
- Provide an adequate number of sites with access to on-campus cable television and satellite downlinks. Increase the number of sites on demand.
- Obtain servers and migrate applications from the mainframe.
- Upgrade the telecommunications switch as needed.
- Modify the university budget to allow for repair and replacement of equipment and software.
- Institute incentives for using technology.
- Ensure the implementation of technology in all building and remodelling plans.
- Upgrade library technologies.

- Pursue cooperative links with other educational institutions and agencies.
- Evaluate the technology plan and the success of key activities.
- Support the development of distance learning.

An important charge of the Technology Task Force was to recommend an organizational structure for technology support. One potential structure was to centralize all technology resources under one director. While the task force acknowledged the efficiency of the central model they were concerned with its potential lack of responsiveness to changing needs of both academic and administrative constituents. A second distributed technology model could reverse the advantages and disadvantages of the central structure and would be more responsive but was not likely to achieve any needed efficiencies. There was also a concern about how a completely decentralized organization would plan and coordinate "big technology" projects. The task force recommended a matrix organization and governance structure that combined features of the distributed and centralized models with local service providers in colleges and administrative offices that would be secondarily associated with centralized university technology service centers.

The proposed matrix model[2] included a formal Technology Planning Board chaired by a technology administrator reporting directly to the Provost. The Technology Planning Board would include Deans (or designees) and Vice Presidents (or designees) from all the major divisions of the university. The technology administrator would be responsible for the various technology support services, and promote technology on campus. The planning board would be responsible for strategic planning for technology at the university, including proposals for funding and the schedule for completion of key activities. A second layer of the proposed matrix was the role of technology coordinator. As envisioned by the Task Force, technology coordinators from each division would have more of a technical management relationship with the directors of the centralized service "centers," for computing, telecommunications, and instructional support. This matrix of directors and coordinators would form collaborative operational-level teams of local and centralized service providers.

## The Resulting Organizational Structure

In response to the external and internal assessments and recommendations, President Leonard Plachta presented his Technology Initiative Plan in October 1995. The plan endorsed the general recommendations of the Technology Task Force. It stated that the objective of technology was to "support and improve teaching, learning, research and service and to enhance the productivity of students, faculty, and staff." A matrix model for information technology coordination, including a Technology Planning Board and a new Assistant Vice Provost for Information Technology position, were created. The Technology Planning Board included the membership recommended by the Technology Task Force and the Directors of Computer Services and Telecommunications. The Assistant Vice Provost for Information Technology reports directly to the Provost and serves as coordinator of computer services, telecommunications, and other technology units on campus. Also, the technology budget will be under the control of the Assistant Vice Provost. Initially the Technology Planning Board, chaired by the Assistant Vice Provost, received the following charges:

- Develop a plan to complete the campus computer network;
- Develop a comprehensive plan for a Technology Training Center to be integrated with the library instructional resource center and the new technological library expansion plan;
- Develop a job description for a new coordinator of distance learning;

- Consider a comprehensive plan to provide every CMU student with a personal computer to assist them in their university studies;
- Develop a plan that would insure that all faculty members will have appropriate computer access.

The Technology Planning Board will also consider partially financing technology improvements with a student technology fee. These broad charges overlap the most pressing technology-related issues reported by many higher education institutions.[3] However, it is difficult to look too far ahead when there are problems that demand immediate solutions. For example, there is great potential for client/server computing to support instructional and business process reengineering. However, client/server solutions require a ubiquitous campus network, hardware and software upgrades, and lots of training. There are many conflicting sources of information about the cost and timeline to move from a mainframe-centric environment to a distributed computing environment. Many analysts agree that migrating to distributed computing environments will: (a) shift cost structures from being capital-intensive to becoming labor-intensive; (b) at least for the short-term, result in high capital costs due to acquisition of more networking, also new clients and new servers; and (c) occur over a period of years rather than months.

## Short and Long-Term Futures

"As it is, we are right on the edge of what works."[4]
(Bill Gates, 1995)

"If you come to a fork in the road, take it."
(Attributed to Yogi Berra)

Bill Gates aptly described the challenge of technology-driven change. The second quotation characterizes the urgency of decisions that face CMU and other institutions. It is important to rapidly move forward with technology planning while taking immediate action on some very fundamental issues and problems that cannot afford to wait. As the campus network is completed, client/server computing will become possible. The empowerment of desktop computing requires managed and coordinated data, communication, and performance optimization. Client/server architecture is an identifiable solution to these needs. However, there are related issues and questions that will need to be solved as we move forward with our information technology initiative.

One issue/problem is to decide the intermediate to long-term value of a mainframe computer as a server in a client/server network. This would not ordinarily be a pressing issue, but our current mainframe is heavily overloaded and usage of existing applications is still increasing at a rapid rate. There are opinions, both pro and con, about the mainframe issue. On the pro side, the proven security and stability of mainframes, rapidly improving price/performance ratios, and operating system evolution into client/server compliant systems seems to offer assurances that an upgraded "legacy" system may serve a substantial future role in a distributed computing enterprise network and can provide a smooth migration path from the mainframe's traditional role as an exclusive server to a future role as a data warehouse and one of many network servers. On the con side, there are concerns that mainframe hardware still has a higher price/performance ratio than smaller servers, is less scalable, cannot be distributed, and is therefore, less flexible. With continuing research and development plus heavy competition among hardware and software vendors, the advantages and disadvantages of mainframes vs. other types of servers are becoming increasingly blurred. Regardless, client/server migration is a complex process that involves improving price/performance ratios for technology but increasing costs on the people side.[5]

A related issue is to how to provide for the significant expenditures related to information technology. This is mostly a function of management of resources but is partly a function of level and permanency of expertise needed to migrate into client/server computing, as well as continued growth with changing technologies. There is little doubt that the cost of technology initiative is high. One way to finance new technology is to discover ways that technology can reduce costs elsewhere. Examples of cost reductions include: relatively lower support costs with centrally managed network-accessible data; reduced use of paper; and as distance learning technologies grow, travel costs can be lowered and physical space can be reduced. Technology can also result in lower personnel costs by automating and streamlining people-intensive processes. This last point is especially important since the most significant cost of higher education involves personnel.

For most institutions, the complexity of technology growth has required very serious consideration of an appropriate balance between in-house information technology staff and external subcontractors. We have taken a very systematic approach in basing these decisions on reliable information. We have learned that external contractors can be used as consultants, project partners, or as an outsource for an entire information technology operation. Such contracts, however, are often finite-term relationships. The transitory nature of most contractual relationships and the importance of mission-critical information systems is a serious concern that should make most institutions wary about overdependence on outside contractors who have little vested interest in the success of an individual institution. It is one option to consider but should be acted upon only after carefully considering all the short and long-term implications.

## Issues to be Addressed

**Technology standards and trends.** One obvious way to reduce technology costs is to standardize hardware and software as much as possible. In most higher education environments, it is virtually impossible to standardize on one platform or configuration. However, arbitrary heterogeneity may result in higher support costs and thus be a false economy. No matter how efficient technology investments are, they will not produce satisfactory returns without anticipating medium and long-term pedagogical, economic, cultural, organizational, market, and technology trends. One example of where many of these issues surface is in the area of distance education. There are many potential delivery systems available for distance learning including interactive television, satellite links, and the Internet. Each of these systems can deliver instructional materials. However, it is important to analyze how comparable outcomes could be achieved with conventional or more cost-effective solutions. The ultimate evaluation of any technology or trend is that whoever can provide the best product for the best price will be the most successful. Every technology purchase is a strategic decision that must balance price vs. performance, obsolescence, and current vs. projected markets and priorities.

**Cost of technology modeling.** It is essential to understand the real cost/benefit of technology. Since many costs and benefits are hidden or indirect, and because technology involves a combination of one-time and variable length recurring costs, this is a very difficult task. For example, to expand our campus network we not only needed to understand the costs of network technologies, but also physical space, electrical, and engineering requirements for locating the network. In our residence halls, this included additional 117v power capacity needed to support increasing requirements for student televisions, microwave ovens, refrigerators, stereos, hair dryers, and computers. Life-cycles must also be planned for computers, software, servers, and networks[6] although most institutions have not accomplished this.[7] The reality is that technology engineering and support are a combination of direct and indirectly-related investments that must be understood and planned for.

**Instructional development, training and incentives.** Technology upgrades will accomplish very little if not used effectively to improve instructional and business practices. In a 1993 federal government report, user training and organizational learning were identified as the two most critical technology issues confronting higher education.[8] Besides training, there may need to be related incentives and recognition for innovative and efficient uses of technology. Highly trained users need less support that is one way to justify training costs. Even with trained users some technical support, especially for instructional development, is needed. However, users must also take a more active role in learning how to use technology.

**Distance learning objectives and strategies.** One technology trend discussed extensively is the involvement with distance education. Historically, the CMU extended degree program, serving more than 12,000 students, has been mostly independent of the on-campus degree programs. Inspired by changing student demographics, increased external competition, and improving distance-learning technologies there is now a sense of common mission and vision between our on- and off-campus programs. The strategic role of distance learning involves selecting the most fruitful technologies to invest in and reengineering instructional delivery. It is important and necessary to assess the relative cost/effectiveness of both traditional and new modes of instruction.

**Continuing reorganization of information technology support.** The *status quo* of disenfranchised central and decentralized technology support was not working very well. The matrix model for information technology at CMU will try to accomplish more fruitful coordination. A good starting point is to view support from the users' points of view. One solution we are considering is similar to an approach used at Brigham Young University[9] which involved assigning each faculty and staff member to a local computer support representative. This local service provider would be a generalist who would be the primary contact person for all technology needs. Complementing the local service provider would be a central service provider that would receive requests for service, try to answer them immediately, then refer them to the local service provider if necessary. The local service provider would provide many general consulting and technical support services and arrange for additional support and services as needed. The most important aspects of this user support function are (1) effective communications between the central and local service providers, (2) efficient support from the central service providers to reduce unnecessary load on the local service providers, (3) access to technical information, documentation, problem histories, frequently asked questions, and deeper levels of support for the local service providers at their remote points of service.

## Conclusions

The various planning processes yielded similar conclusions about the strategic importance of technology growth, broad goals, and an organizational structure for achieving those goals. Details of this organizational change will need further and probably continuing refinements. Some activities, such as expanding the campus network are already underway and are prerequisite to proceeding with both instructional and business process reengineering. The newly created Technology Planing Board will have an opportunity to establish technology priorities, increase efficiency, and achieve the best return on investments. The matrix organization will also have a very exciting opportunity to provide improved user services by coordinating the efforts of local and central service providers. CMU is committed to the technology initiative and has the realization that technology will also require continuing and increased investment. Financing technology will be derived from more streamlined instructional and business processes, student technology fees, and more aggressively pursued external sources of revenue. The university will also continue to evaluate the selective use of external consultants and partners as resources for additional expertise and operational economies.

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# The Financial Mythology of Information Technology: The New Economics

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Abstract

*One of the most misunderstood aspects of managing information technology is understanding the attendant economics. The rate of technical advancement is accelerating, demand is intensifying, standards and architectures are changing daily, prices are falling, but total costs are growing. Yet the legacy based fiscal thinking of both technologists and financial officers has changed little in the face of these new realities. Understanding the attendant economics of information technology is a necessary first step toward developing sound financial strategies to accommodate technological advancement.*

The financial truths surrounding information technology at educational institutions have never been particularly clear. The economics of these investments are often steeped in an intellectual haze that can be described as the financial mythology of information technology (IT). This mythology is nourished by an unusual set of economic and technical factors that often place the financial analysis of IT outside the comfort zone of not only technologists, but financial officers and senior administrators as well.

This paper will show that the principal forces driving the new economics of information technology are: (1) it is steadily increasing in value, (2) academic demand for information technology and computing power is virtually unlimited; (3) the per unit price of information technology is declining rapidly; and (4) the total cost of owning and maintaining these systems is steadily rising. In other words, the potential benefits are truly revolutionary and the demand is insatiable -- but the falling prices mislead many to expect cost savings that will never materialize.

These forces, combined with the breathtaking rate of change inherent in IT, produce a unique economic environment that seems to breed financial paradoxes. The new economics are formidable. Shortening life cycles will force fundamental changes in how institutions manage these assets; the increasing value of IT and the pressure to spend more on it will make the financial crisis facing many institutions worse; and the ability of new technologies to transcend time and distance will intensify competition among institutions. Information technology will represent the single biggest opportunity to either enhance or damage an institution's competitive standing. Academic, technology, and financial leaders will have to come together as never before to address these issues.

## The Institutional Context

The potential for information technology to do good is unarguable and contributes to a pervasive mythos that captures the imagination of individuals from every walk of life. In this information era, the expectation is that information technology will be revolutionary and transformational. The record is replete with visionary examples of how individuals, institutions, and society will change for the better -- information will be at our fingertips; ubiquitous nomadic computing will be the norm; productivity will increase; society will experience increased democratization; colleges and universities will provide breathtaking breakthroughs in teaching and learning; and individuals will be free to reach new levels of self-actualization, all as a result of using the new technologies.

However, educational organizations and their patrons must realize that managing the technology revolution will require a focus on financial management that is unprecedented. Unfortunately, it may be fair to characterize the dominant culture of these organizations as being contemptuous of financial activities that attempt to quantify academic endeavors, and suspicious of those who advocate or engage in them. To the extent this is true, these attitudes will need to change if academe is to grapple effectively with the sweeping impacts of information technology. The numbers are going to be too big not to get serious about financial analysis.

In the end, the answer to "if" or "when" these sweeping technical advances will ever take place won't be found on the drawing board of some network engineer, computer scientist, futurist, or even a chief information officer. Instead, these answers will come from the strategic plans and business analyses of pan-university planners, senior business officers, college presidents, trustees, and legislators. This flows from the realization that there is no technical or pedagogical problem involved here as daunting as the bottom line. The technology revolution won't come cheap. Until the business case is quantified and verified, the promise of using information technologies to realize the anticipated benefits will remain just that -- a promise. This paper briefly examines several of the legacy-based assumptions that contribute to the financial mythology of information technology and identifies the new economic realities that IT is bringing to bear on academic institutions.

## The Value of Information Technology

The issue of valuing IT investments carries a mystique. The question of how to value technology is being asked at campuses everywhere and is often viewed as a question that is impossible to answer correctly. I propose a new question: Can we value information technology without knowing its value? I believe we can. While we may not be able to assess the value of information technology in some absolute sense, we can clearly observe that its value to our institutions is increasing over time. This is the most critical aspect of value and the one most worth understanding.

*The value of IT is increasing.* Information technology has tremendous potential. Computers can already talk; they process visual images; and will even have the capability to sense smells in a few short years. It would not be unreasonable within the decade to have our personal computers wake us up in the morning, read us the newspaper, report on the weather, and download the traffic report to our car before we leave for work. Scholarly scenarios have computers assessing prospective students' knowledge base for course placement; managing curricula, interactions, data, and visualizations; and building lifelong connections to scholarship through distance learning technologies.[1] The potential value of information technology is limited only by our imagination and our willingness to invest in change.

What was optional only a decade ago is now so valuable it is a necessity. Neither campus libraries, nor laboratories, nor research facilities would be viable today without computers. Over the last decade we've witnessed revolutionary changes in the level of computing and networking power that resides on the faculty desktop. The technology does so much more than it did a few years ago -- the computer is already indispensable.

The problem is that many people don't realize its increasing value because they have incorporated the expectation for constant improvements into the very nature of information technology. For example, the Commerce Department estimates that 70% of America's top 500 companies use artificial intelligence (AI) in their computing. The quandary is that this innovation doesn't get the credit it's due. Whenever artificial intelligence works, it ceases to be called AI; instead, it becomes an integral part of the system and is then taken for granted.[2] This phenomenon appears to be common whenever an explicit valuation of information technology is called for. Nevertheless, the implicit evaluation is changing. Just as we would be very reluctant to give up our heating, air-conditioning, or phone, we are quickly becoming equally loath to give up our computers.

This paper was written on a computer that corrects my spelling as I type, monitors my e-mail communications in the background, reminds me of important appointments, travels easily in my briefcase, and scans the Wall Street Journal daily for articles relating to information technology -- and it cost less to buy than my first computer purchased ten years ago. More to the point, that original computer wasn't able to do any of these things. This computer is not just more valuable to me than my previous ones, it has become mission critical to what I do.

Each successive generation of information technology brings new levels of performance and functionality that weren't there previously. There is very little information technology on campuses today that couldn't be replaced with something that is both less expensive and superior in performance and function. It seems clear that the value of information technology is increasing from year to year, as well as its respective value to our institutions. IT supports teaching, learning, communications, and collaboration in ways that simply weren't available only a few years ago.

*The aggregate value of IT.* The total value of information technology is greater than the sum of its parts. To the extent that enterprise-wide systems function in aggregate like ecosystems, much of IT's value grows exponentially as its supporting infrastructure and interconnections grow richer. For example, the value of a departmental e-mail system is enhanced if the entire campus community is also on the network, and is greater still if the campus is connected to the Internet. Similarly, connecting faculty to a campus network would be valuable, but connecting the entire campus community of faculty, staff, and students would be greater still. There is a multiplying effect on the value accrued to the institutional that goes beyond their sheer numbers.

It appears that the cost/benefit curve for technology investments is a step function, where particular levels of investment can produce superb value. The challenge for financial planners is to target the specific level of functionality desired and identify the minimum investments needed to move from one plateau to the next.

### The Demand for Information Technology

Years ago Pablo Picasso quipped that "computers are worthless, they only give answers." While his assertion may have had great validity at the time and may still have in philosophical circles, it appears today that his conclusion is completely wrong even though the original reason he gave is still true. The problem for educational institutions is that there's no end in sight to the questions. Thus, there is no end in sight for the demand for the computers and information technology that help provide the answers.

The demand for information technology is driven by more than just the need to answer questions. Successful implementation almost always creates new demand and expectations that grow exponentially. Computationally-intense researchers can bring any quantity of CPU power to its knees simply by relaxing a few restrictions in their models. The challenge is to accept this exponential growth in demand and work to develop financial and management strategies to accommodate it. The academic value of IT systems is growing -- it is only natural to expect individuals, departments, schools, and institutions to desire more of it. The fact that they do is an affirmation that our scholarly values are strong and that our campuses are vigorous.

*The demand for large systems.* Researchers across a range of disciplines will continue to propose questions that can only be answered using the largest systems available, and once these questions are answered, new and more demanding questions will follow.[3] The need for large machines to help solve large problems will persist and grow. Furthermore, the demand for enterprise wide solutions for data warehousing, e-mail, and administrative functions will drive demand for ever larger central administrative systems. Electronic libraries with digital archives and advanced search and retrieval engines will require large systems currently unavailable on campuses.

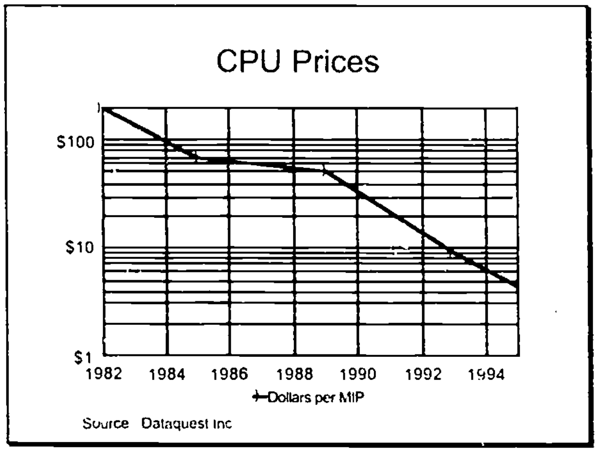
Twenty years ago the entire campus computing capacity was centralized in the academic computing center. Today, personal computers, local area networks, and distributed computing environments have changed that. While it is true that the trend is for central computing to represent a smaller percentage of the total computing resources available on campus, it is equally true that this key resource has been growing in absolute size, and will need to continue growing. Computing power will continue to be deployed throughout campuses at a level that is appropriate to meet aggregate demand. Desktop systems will deliver some minimum level of power suitable for personal use, departmental servers will be larger to meet the demands of multiple users and larger databases, schools will require even more powerful computers and storage systems to meet their demand, and institutions will deploy central academic resources to meet the remaining level of aggregate need. The National Science Foundation identifies this final campus level as the area most in need of financial support and the weakest link in the national pyramid of academic research computing.[4]

*The demand for distributed systems.* Today's conventional wisdom is heavily in favor of distributed computing systems and client server architectures. Individuals on campus want the greater personal power and freedom of choice that is inherent in these systems. PCs and departmental LANs are increasingly expected to support multimedia, visualization, virtual reality simulations, and disintermediated teaching and learning opportunities. Larger networks are facing similar demands; consider ARPANET, the first large-scale computer network used by faculty. It was originally designed to link computer scientists at universities to distant computers, thereby permitting efficient access to computational resources unavailable at their respective institutions. A minor feature called electronic mail was included only as a sidebar to the host computing function. Yet electronic mail rapidly became one of the system's most popular features.[5] Today, traffic on the Internet is growing at 10% per month, XXX new servers were connected in 1994, and the advent of the World Wide Web is driving even more growth.[6]

*Increases in demand.* The demand for information technology is not simply a "change in quantity demanded" as prices fall. In this case there is an actual "increase in demand." The subtle difference in this economic jargon is an important distinction with significant ramifications. A change in quantity demanded describes how individuals tend to desire more of almost anything when the price is lower or when their income increases; for example, entertainment, travel, or vacations. Conversely, an actual change in demand describes a shift in the demand curve for that product -- a situation where more is demanded at all price points. This is the case with information technology. This demand characteristic is a major driver of the economics of the entire technology industry. It is what allows technology providers to lower prices continuously. It means that technology manufacturers can expect their revenue, and profits, to grow even as they drop their prices radically.[7] Without this shifting demand function, the economic viability of information technology would be much different than it is today.

## The Cost of Information Technology

It is commonly reported today that buying computing systems has never been cheaper. By some accounts, the price of buying computers has been halved at least every three years.[8] However, this encouraging news comes with several caveats. First of all, lower per unit prices for individual components of a computer system does not always translate into a lower acquisition price for today's average system. For example, no one would argue that the per unit price of memory, processors, and most peripherals for personal computers has fallen dramatically. On the other hand, as mentioned earlier, today's average user demands more memory, more powerful processors and more peripherals than the average user did three years ago. The end result is that we get a lot more for what we paid three years ago, but in many cases the actual acquisition price may not be falling significantly. Worse yet, demand for even more powerful systems that are now financially viable could actually drive the average acquisition price up.

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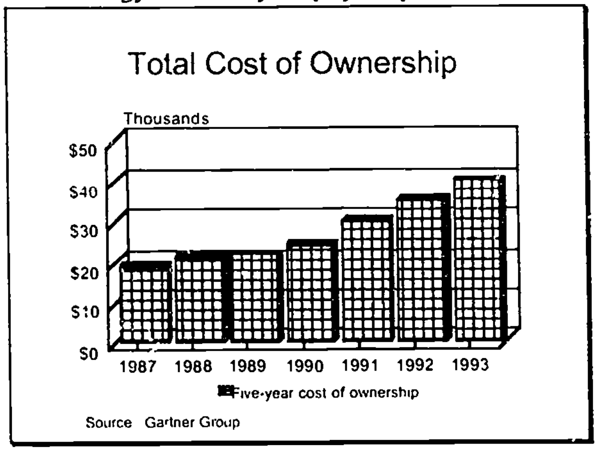
The second caveat is that the total cost of owning technology is rising. More sophisticated and distributed systems require more technical support, more training, more peripherals, and more time. The price of technology is what you pay to purchase it. The cost includes the price as well as all the other expenses associated with owning, operating, and maintaining it. Every new generation of technology introduces its own unique set of incompatibilities and obsolescence of peripherals. The net effect is a host of new costs that include training, user support, and time to reconfigure networks. As long as total costs are increasing as demand increases, it appears that the best result that institutions can hope for are solutions that support future cost avoidance rather than actual cost reduction.




*The cost of distributed systems.* The growth of distributed computing environments, with their inherent complexity, significantly contributes to the increase in total costs that campuses face. The total cost of distributed systems may be ten times or more the purchase price.[9] These costs, including the opportunity cost of having research faculty administer local computing centers, may very well exceed that of central systems. Moreover, studies by the Gartner Group have shown that the cost of owning and maintaining a PC in a distributed environment has grown steadily over the last five years.[10]

*The cost of success.* One of the paradoxes of managing information technology is the high cost of success. Successful technology implementations almost always leads to greater expense. A marginally effective e-mail system or networking environment on campus will result in only a limited utilization of the services. However, history shows that once a system becomes functionally viable there is typically an explosion in the number of users as well as in the level of usage. The result is an increase in demand and an increase in total cost as more equipment is needed and better support and training become an imperative.

Emerging technologies will almost certainly repeat this pattern, whether they be distance learning, multimedia, or some other innovation. The shift from traditional paper-based libraries to electronic libraries is a case in point. As libraries move to put more and more electronic information on-line, few if any of their historical services are being displaced.[11] Even though the expectation is that full text retrieval will eliminate the need for books, it may instead create new requirements for printing on demand. The effect is that these electronic services are adding new costs in terms of equipment, training, and operations, with little in the way of cost savings from discontinued activities. There is no evidence that information technology has lowered the total cost of operating academic libraries.

*The sociological cost.* The largest costs of IT will come from the social changes it produces. Fundamental changes in the positions of individual stakeholders are taking place. Technology is changing the role of libraries and supporting the privatization of information. The advent of distance learning will affect the nature of faculty-student relationships. Changes of this nature will certainly spawn new costs. Strategies that support continuous or incremental change of social norms, not revolution, should dominate in this environment. As John Kotter makes clear, planning for transformations is the wrong goal.[12] Planning for constant incremental change not only produces better results, but can help avoid the most expensive disruptions in organizational effectiveness.

### The Economics of Information Technology

As described above, the value of information technology is increasing over time, the demand is swelling, and the price is falling while total cost is growing. How do these observations affect the fundamental economic equations that determine the wisdom of investing in and managing these systems?

**Life cycles.** The first step toward understanding the new economics of information technology is to realize each new generation has an economic life-cycle that is independent of its functional life-cycle. Computers rarely wear out. Instead, they become economically obsolete and are replaced. The record of academic institutions is littered with examples of technology at every level -- desktop PCs, departmental servers, campus networks, and shared regional super computers -- that have become functionally obsolete long before their hardware stopped working.

*End of life.* Recognizing the end of life for information technology equipment is not always obvious, nor is it easy. The problem with determining end of life on most campuses is the decision rule they use. The test on most campuses is, "if it's still running, it must be good for something." The paradox is that a five year old computer still looks and runs as well as it did when it was new, even though it may be obsolete. It does everything it did then and more, and whatever was prone to break has already been fixed. Nevertheless, it may be well past its economic life. An economic life cycle is defined as the useful financial life of an item. In other words, the life cycle is the number of years one should plan to keep a piece of hardware or software. For example, a life cycle of three years for a computer implies that at the end of three years, the computer is either: (1) no longer suited for its intended purpose (e.g., Intel 80286-based servers won't run Netware 3.11), or (2) maintenance and support have grown to the extent that it is cheaper to replace the computer than keep it, or (3) new requirements or performance standards (such as portability, ease of use, user interfaces, visualization, networking, processing power) have necessitated its replacement to meet user needs.[13] Keeping information technology longer than its economic life cycle is a mistake. Not only does it waste current money, but it forfeits the advantages inherent in new technology.

*Replacing old technology.* When compared to other capital assets, the replacement of information technology systems is unique. The difference with technology is you don't just replace what you had, you upgrade it significantly. Replacing traditional assets, like cars and office furniture, results in something basically the same as what you started with, only newer. On the other hand, a five year old desktop computer (e.g., a 16 MHz Intel 80386-based machine) could be replaced with a 100 MHz Pentium-based, multimedia, portable computer for less money. These two computers are fundamentally different. The new one not only does the old things better, it does important new things that the original didn't. The economic equation has changed.

*Determining life cycles.* There are several ways of determining technology life cycles that draw on quantitative assessment methods. One is to take into account technology generations. In the simplest example of this method, consider a single faculty member who uses a personal computer to support his or her computationally-intense research. If the area of research is competitive, which is almost always the case, the researcher will need to maintain a competitive level of computing. It could be argued, all other things being equal, that this researcher could afford to be no more than one generation of processing power behind his or her peers -- otherwise the research would suffer from time delays or poor analytical depth. If new CPUs are introduced every three years, the maximum competitive life cycle for this researcher would be six years -- three years for the current generation, and three more for the next. After that, he or she would have to upgrade to stay no more than one generation behind.

*Changing life cycles.* In the 1980s Intel produced a major new generation of microprocessors approximately every three and a half years.[14] Currently, the time between generations is shorter, perhaps two years or less. The implications for life cycles are obvious -- they're getting shorter. As a result, it's more expensive for institutions to stay on the leading edge and be competitive in the 1990s because of shorter technology life cycles, and it's likely to be even more difficult in the next decade. All indications point to an accelerating rate of technological change which will continue to shorten life cycles.

Even if institutions were to ignore the competitive aspects upon which this generation approach draws, they would still be in for trouble when managing the changes their students will bring to campus. Today, $1,800 buys a 75 MHz Pentium computer with 8 MB of RAM and 500 MB of disk. In five years or less, $1,800 will buy a 600 MHz fifth-generation Pentium computer with 64 MB of RAM, over 6 GB of disk, and an ultra fast network connection. Students will be bringing these machines to campus in large numbers whether they are required to or not, and this alone will drive increased expectations, expensive additions to campus networks, and a need for

What $1,800 Will Buy

| | 1995 | 2000 |
|---|---|---|
| Processor | Pentium fifth-generation | Pentium eighth-generation |
| Speed | 60 MHz | 600MHz |
| Memory | 8 Megabytes | 64 Megabytes |
| Storage | 420 Megabytes | 8 320 Megabytes |
| CD-ROM | Double-speed | Six-speed |
| Monitor | VGA | SVGA+ |
| Outside link | 14 4K bps f m | 100M bps net |

Source Dataquest I

additional support services.

It won't be easy having faculty and seniors using old systems while incoming freshmen enjoy new technological advantages. Expectations are going to rise. Life cycles can't be ignored, nor can they be avoided. Understanding them, accepting them, managing them, and planning for them goes to the heart of the new economics of information technology.

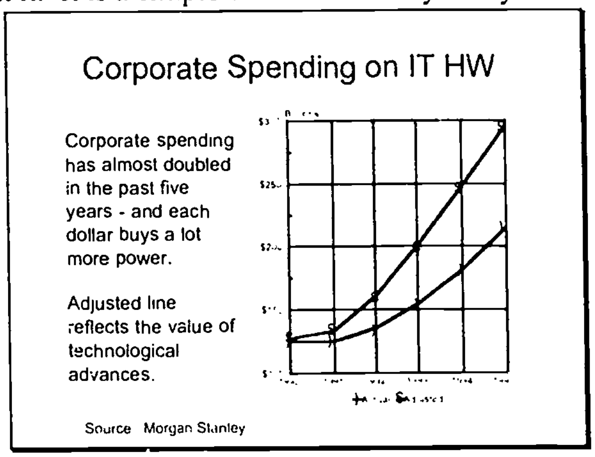
**Asset management.** The principles of asset management that apply to buying a computer are fundamentally unlike those of buying a truck. If the physical plant purchased a half-ton pickup truck for $25,000, with an expected life of five years, it would have a capital cost of $5,000 per year. At the end of five years, the truck could be replaced with another truck that would cost more but still be more or less functionally identical. (A half-ton pickup truck will still only carry half a ton five years from now.) One way to help make this investment pay better would be to invest more in maintenance and amortize the cost over more years. The rule of thumb to optimize this type of investment is to amortize it for as many years as possible.

Computers, on the other hand, are quite different. If the physics department purchased a $25,000 computer and amortized the expense over five years it would also cost $5,000 per year. The difference comes when considering what happens when the machine is replaced. In this case, the physics department will be able to spend significantly less on the replacement and still receive a new computer that is superior to the one it is replacing. This fundamentally changes the asset management paradigm for this equipment.

Given the superior performance of the replacement machine, the lower price, and the growing demand, the whole premise of evaluating information technology investments by the same methods used to evaluate the truck seems silly. Yet most campuses do just that. A strong argument can be made to turn the model on its ear. Increasing the amortization period for technology investments may actually make the investment decision worse. Instead of buying the biggest computer necessary to do the job for five years, it seems compelling to consider the case of buying the smallest computer that would do the job for three years. The question is, would the physics department be better off buying a $25,000 computer for five years, or a $15,000 computer for three years, and then replacing it sooner? It seems obvious that the second case is superior. It has the same annual cost and the department gets the benefit of replacing it with a superior machine for less money after only three years instead of five. In cases where this is true, the rule of thumb for making computer purchases is to adopt a life-cycle model where you buy as little as possible and keep it for as short a time as possible. The challenge for planners is to balance the constant academic demand for more power today against a financial strategy that will provide for superior power over time.

*Saving versus gaining.* In the above example, the physics department actually has a strategic choice of how to manage the replacement of technology. At the end of three years the department can choose to either: (1) keep its computing power at a constant level and lower its annual expenditure by buying something with the same power for less money; (2) grow its computing power by holding it spending constant and taking advantage of new economies; or (3) expand its real investment in IT by growing its level of spending. Case one can be rejected as a strategy of stagnation -- regardless of the life cycle length, it assumes no growth in power or capabilities. The strategic choice is actually between holding the capital budget constant or growing it. Current evidence shows that private industry has adopted the strategy of growing its capital budget for IT hardware.[15] Trends showing increased spending on IT among educational institutions suggests that a similar conclusion within the higher education community may be inevitable.[16]

**Financial pressures.** As long as institutions can expect a continual improvement in their return on investments in information technology, they will be compelled to spend an increased percentage of their budget on it. It is a simple economic reality. Any organization in a competitive environment will be forced over time to invest more of its money where the return is greatest. In the case of information technology, where it pays to invest today, it will pay even greater dividends to invest even more tomorrow. Regrettably, these forces may not always be well understood or recognized explicitly. Nevertheless, they are quite real, and are already affecting most institutions. Many institutions feel the pressure growing to invest more in technology, yet struggle to accept IT's relentless nature. They scrutinize investments on a case-by-case and school-by-school basis but often fail to see the big economic picture inherent to IT investments.




Colleges and universities will have to spend more money on information technology simply because it benefits them to do so -- it's a better alternative than whatever is second best. There is no other asset among their resources that improves its cost/benefit ratio every year. The only other possibility is their human resources. If the return on personnel is increasing, it is almost certainly linked to increased productivity derived from new technology.

**The business case.** Who is responsible for developing a business case for information technology? Developing a business case for information technology in higher education is difficult. Colleges and universities have their own unique brand of conventional wisdom and peer review that manages most critical decisions well. Information technology seems to be an exception. It doesn't fit well with the existing political system and decision making structure. For example, deans are often out of the loop when it comes to technology issues. They typically don't know much about IT, and faculty tend to bypass them when dealing with computing issues. This is because there's usually an administrative or academic computing organization operating outside of the deans' normal sphere of influence that fields these calls. Exacerbating the problem is the fact that institutional financial officers are also out of the IT decision making loop. That leaves technologists holding the bag for developing the business case.

This shift in authority for decision making contributes to the mythology surrounding the economics of information technology. All three parties -- deans, financial officers, technologists -- see a different set of facts. As a result the business case is poorly understood, under developed, crudely articulated and disseminated, and often misses the key elements of what the analysis should be all about.

*The business question.* Traditional wisdom governing technology investment decisions views the investment decision primarily as an expense issue. In reality it's a cost/benefit issue, where it's an investment in both the goals of the institution as well as the individuals charged with advancing them. No dean or department head would fill a faculty vacancy based solely on the fact that one applicant might be less expensive than another. It should be equally ridiculous to make investment decisions for technology based solely on cost. Moreover, many faculty might actually argue that the "best" possible candidate should always be hired, regardless of cost -- a position few would advocate for technology. The financial decision to purchase and manage information technology cannot be based on minimizing cost, but instead needs to be based on maximizing the net return of the investment.

*Teaching and learning.* As mentioned earlier, part of the promise of information technology is its tremendous potential to improve teaching and learning. What will be the business case for technologies that support teaching and learning? Are distance learning, multimedia applications, and on-line information services going to be a financial cash cow for colleges and universities? Not likely. Justifying investments in technology for teaching and learning will have to come from either greater benefits (e.g., better student learning), or lower costs (e.g., fewer faculty), or higher revenues (e.g., more students).

It seems unlikely that technology investments will truly be able to disintermediate students from teachers enough to allow for either significant reductions in faculty or increases in students. If information technology should significantly disintermediate student learning from teachers, it would mean that technological solutions to providing education are equally viable to traditional campus experiences. This would create new and alluring opportunities for private companies and could throw our traditional educational model into jeopardy. If the promised disintermediation doesn't prove effective, and teachers are needed in similar numbers and ratios to what is needed today, then the business case for investing in information technology for teaching and learning will rest primarily on a scenario that relies on valuing greater student le rning. If this is the case, which certainly appears to be most likely, then institutions will have to grow their technology budgets without significantly reducing their faculty. They will be faced with the hard decision of either raising the price of an education or reallocating current budgets to eliminate inefficient and redundant programs.[17] This prospect is further complicated by the fact that higher education has few mechanisms available for measuring and demonstrating higher value for its primary product.

**Fee versus free services.** Central computing facilities and libraries face the question of whether to charge for some or all of their services or to provide some or all of them for free. This is often referred to as the "fee versus free" problem. The dilemma faced by these organizations is how to provide the best possible level of service to all possible users while also being efficient and equitable. The history of the debate is best documented in the library literature, where equity arguments generally have prevailed over any scheme to pervasively charge for service.

From a fiscal perspective it is an error to structure the argument in this manner. The issue has never really been a question of fee versus free, instead it is a question of fee versus subsidy -- a much different issue with different implications.[18] In this context, the issue becomes one of assessing the costs and benefits of the entire user community under each of the two possible cases. What is important is that under either of the two schemes there will be a different allocation of costs and benefits to the user community -- although there is no clear answer yet as to who might benefit the most or by how much. However, where services are to be subsidized, the planning task is to determine the appropriate size of the subsidy as well as the primary audience the subsidy is intended to serve. Subsidizing all services to all groups will never be economically viable.

**Competitive economics.** The biggest institutional downside of new information technologies is its potential impact on inter-institution competition. For example, if distance learning, enabled by IT, becomes viable it could drastically change the competitive landscape. One result would be to break down the regional barriers to competition. If it were financially viable for State College to deliver education at a distance, what is to stop Out-of-State University from delivering competing offerings? A second consideration is that the cost of teaching "personalities" could go through the roof. Like the market for TV personalities, the market for teaching personalities in a distance learning environment could lead to some unpleasant dilemmas for colleges that desire star performers. Assuming that distance learning becomes viable, it implies by definition that new competition will be inevitable. Similarly, if there is new competition, the one thing we can predict with certainty is that there will be winners and losers.

As another example, should the notion of electronic libraries become viable, the potential impacts could be equally dramatic. Consider the case where major Research-I university libraries have, for the bulk of their holdings, on-line searching and full-text retrieval available over the Internet. Library holdings have been, and still are, an important factor in accreditation and institutional ranking decisions. In this electronic library scenario, smaller colleges with more limited financial resources would have an incentive to leverage these on-line libraries and downsize their own facilities, effectively free-riding on the investments of other institutions. If the accreditation process ever recognizes the significant value of "access" to information that the new information highway paradigm emphasizes, wealthier schools with large electronic holdings would have an incentive to either withhold services from the Internet to preserve their status or attach fees to prevent freeloading. In other words, if on-line access to searching and retrieval becomes truly valuable as technology visionaries suggest, large holders will have financial and competitive reasons to withhold it or charge for it.

In either event, the vision of ubiquitous access to free information would be in jeopardy. Moreover, as on-line services in general become more financially viable, the trend of increased privatization of information and education will accelerate -- again threatening the vision as well as changing the economic equations that colleges face.

## Conclusion

In summation, one of the most misunderstood aspects of managing information technology is understanding the attendant financial issues. The rate of technical advancement is accelerating, standards and architectures are changing daily, and per unit prices are falling. Yet the legacy-based thinking of both technologists and financial officers has changed little in the face of these new realities. Rationalizing financial strategies to accommodate technological change is an imperative for effective IT investing. Financial officers will have to accept a new set of economic realities that will in turn change how institutions manage their investments in technology. CIOs will have to abandon their dominate financial strategy of positioning IT as a tool for cost reduction, and institutions will have to accept the verdict that they will be spending a greater percentage of their budgets on information technology.

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